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PREFACE.

This work is intended as a Reading-book for Senior Classes in Schools.

It consists of two parts: I. SCIENTIFIC; II. LITERARY.

The Scientific Part embraces lessons specially written for the work on

PHYSICS, HUMAN PHYSIOLOGY, ZOOLOGY,
GEOLOGY, AND BOTANY.

Each of these subjects is illustrated by wood-cuts, and the Geology is accompanied by a Geological Map of the British Islands. All technical terms are explained, and their derivation given.

The Literary Part contains SELECTIONS FROM THE POETS, from Spenser to the present day, arranged in chronological order, and SELECTIONS FROM THE PROSE-WRITERS, from Hooker to the present time, similarly arranged.

The Selections are accompanied by explanatory notes, and an INDEX OF AUTHORS is given at the end of the book, containing brief notices of their lives and works.

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PHYSICS.

Introductory.

PHYSICS or PHYSICAL SCIENCE, from the Greek word *physis*, nature, was the name originally applied to the whole of man's knowledge regarding *Nature* or the material universe. The universe is composed of an immense variety of materials or objects, many of which bear a general resemblance to each other. This resemblance has led to a classification of these materials into three Kingdoms—the ANIMAL, the VEGETABLE, and the MINERAL; and the minute description of these classes constitutes the science of NATURAL HISTORY. Besides this resemblance between particular objects, it has been found that certain motions or changes, called *phenomena* [Gr., 'appearances'], are continually going on among the objects themselves. And as, for convenience, the materials of the universe have been arranged under separate classes, there is likewise a classification of the phenomena to which they are subject. There is one class of phenomena which are always accompanied by a very decided change in the bodies themselves: the science which treats of these phenomena is called CHEMISTRY. A second class, caused by the action of *Life*, is included under the science of PHYSIOLOGY. A third class is formed of those phenomena which are caused by the action of *Mind:* these belong to the science of MENTAL PHILOSOPHY. The fourth and last class of phenomena includes those which are neither accompanied by any essential change in the object, nor caused by the action of life or of mind, but which are due simply to the properties of bodies as bodies, and are common to all objects, animate or inanimate. It is to the knowledge of this last class of phenomena that the name of PHYSICS, PHYSICAL SCIENCE, or NATURAL PHILOSOPHY is now properly applied.

Properties of Matter.

Under the name of Matter is included everything that we become acquainted with by means of our senses. Farther on, Matter will be treated of under the forms, Solid, Liquid, and Gaseous; but there are certain properties, common to all kinds of matter, which must first be described.

1. **Extension** or **Magnitude.**—Extension or magnitude is the property of matter which implies that it *is extended* or occupies room or space. Bodies are extended in three directions, or have three *dimensions* or measures—length, breadth, and depth. Width is another term used for breadth; and for depth we often use height, and sometimes thickness. By these three dimensions the *shape* of a body is determined. If we think of a stone, it may be round or square; or if of a mountain, it may be high or low; but it will have some shape. When we speak of the size of anything, we can do so only by comparing it with something else, the size of which we do know; for example, a boy describes something to his friend as being as big as his fist, or as big as his head. For the sake of convenience, standards of measurement have been fixed upon to be used by all. For length, the inch is the standard; and we say a thing is so many inches or so many feet long. For measuring a surface, which has both length and breadth, the standard is a small square an inch long and an inch broad, called a square inch; and a surface is said to contain so many square inches, or so many square feet. Lastly, for solids, which have length, breadth, and depth, the standard is a small cube, each side of which is a square inch; and the bulk or volume of any quantity of matter is said to be so many cubic inches or so many cubic feet.

2. **Impenetrability.**—The word impenetrability must have a peculiar meaning here, for there is no material so hard that it could not be *penetrated* or pierced, if proper instruments were used. Impenetrability, as applied to matter, means simply that *two bodies cannot be in the same place at the same time.* A nail can be driven into wood, but it is impossible that there can be wood in the very space occupied by the nail: the particles of the wood are merely forced more closely together, in order to make room for it. This property of matter is obvious in regard to solid bodies, but it is not so obvious with regard to fluids. Common air offers so little obstruction to our movements, that we are apt to forget that it is a real material body. That it is so, can be shewn by many simple illustrations. When a bladder is filled with air, it is impossible to press the sides together without bursting the bladder. If a tumbler be put, mouth downwards, into a vessel full of water, the water does not fill the tumbler completely, because it is prevented from doing so by the

air in the tumbler. This property of air is taken advantage of in the diving-bell. That a liquid cannot occupy the same space with any other body, is clear from the fact, that if anything be put into a vessel full of water, the water will flow over, so as to make room for the body put in.

3. **Divisibility.**—The nature of matter is such that it can be divided to an extent far beyond the limits perceptible to the senses. A grain of gold, the bulk of which is one five-thousandth part of a cubic inch, can be beaten out so as to cover 57 square inches. The leaf thus formed is so thin that a pile an inch thick would contain 282,000 leaves. The microscope has revealed the existence of animals, a million of which would not occupy more space than a grain of sand. Yet these animalcules, as they are called, have members and organs, and display all the appearances of vitality. How shall we conceive the smallness of the tubes or vessels in which their fluids circulate, and the minuteness of the particles of matter composing these tubes and fluids! It must not, however, be supposed that there is no limit to the divisibility of matter. On the contrary, there are many reasons for believing that there is a limit somewhere; and that there are ultimate particles of a determinate size and shape, incapable of further subdivision. These assumed particles are called *atoms* [Gr. *atomos*, from *a*, not, *temnō*, to cut].

4. **Cohesion.**—Cohesion is the property by which the particles of matter *stick together* and form masses or bodies. Without this force to bind its particles together, matter would only exist in the shape of sand or powder. There is another kind of attraction, called the Attraction of Gravitation, by which one body acts upon every other body at any distance, however great; but cohesion acts only when the particles are in contact, or when the distances between them are imperceptible. Thus, when a stone is broken, the fragments cannot be made to adhere, although placed together again; in other words, the cohesion which existed between the particles before will not operate after they have been separated. The degree of cohesion in all bodies, however, is not the same; and this gives rise to what are called *states of aggregation* of particles, of which there are three—*the solid, the liquid,* and *the gaseous.*

When the air has been entirely drawn out of a vessel by an air-pump, and a small quantity of gas introduced, the gas does not remain of the same bulk, but spreads itself throughout the whole vessel. This proves that there is in the gas itself a force repelling the particles with a power sufficient to overcome their own weight. This force was formerly called *Repulsion,* but it is now known that it is not an essential property, but the effect of heat, which is a form of motion among the particles. In addition to the cohesive force which binds the particles of matter together, there is thus another which repels them from each other. When the cohesion is greater than the repulsion, the body is firm and

solid; when the cohesion and repulsion seem to be equal, the particles are less firmly united, are freely movable among one another, and the body is said to be *liquid;* when the repulsion is greater than the cohesion, the particles are still more freely movable than in liquids, and such bodies are called *gases.*

Certain names have been applied to different states of cohesion:

(1) *Tenacity* is the quality by which a body resists being torn asunder, and depends on the intensity of the cohesive force. An iron wire one-tenth of an inch in thickness will sustain a weight of 700 pounds. Fibrous substances, as silk and flax, possess great tenacity. The most tenacious of all substances is steel.

(2) *Malleability* means the capability possessed by some metals, as gold, silver, copper, &c. of being *hammered out* into thin plates. This quality depends on the union of softness and tenacity in the bodies possessing it; being soft, their particles can be made to change their position with regard to one another; being tenacious, the particles will not readily separate.

(3) *Ductility,* the capability possessed by a metal of being *drawn out* into wire, is of the same nature as Malleability, both depending on a certain degree of softness and great tenacity. These properties are not, however, identical, for the most malleable metals are not the most ductile. The most malleable metal is gold; the most ductile, platinum.

(4) *Hardness.*—Both in malleable and in hard bodies, the force with which the particles stick together is very great. In a malleable body the particles can be made to change their position by sliding or rolling on one another without separating, while in a hard body they resist change of position, and, if forced, separate or break. The relative hardness of two bodies is ascertained by trying which of them will scratch the other. Thus glass will scratch gold, and even platinum. All precious stones are very hard. The diamond is the hardest substance known, and is used in cutting glass.

(5) *Brittleness* is closely allied to hardness, for most hard bodies are brittle. It would seem to be the opposite of Malleability, for on a very slight attempt to displace the position of the particles, the body flies in pieces. Glass has this property to a remarkable degree.

The five properties enumerated above are due to certain states of the cohesion of the particles of a single solid body; there is also an attraction between two different bodies, which makes them stick to each other by their surfaces. This attraction is called *adhesion.*

5. **Adhesion.**—(1) *Adhesion between two solids.*—If two lead bullets be taken, and a piece be cut off each, leaving perfectly smooth surfaces, the bullets will stick together when these two surfaces are joined; or if two pieces of glass be laid upon each other, they stick together with considerable force. (2) *Adhesion between a solid and a liquid* is seen

whenever a solid which has been put in a liquid comes out *wet*. This attraction affords an explanation of what often happens when water is poured from a vessel—the water runs down the outside of the vessel, instead of flowing as desired. (3) *Adhesion between solids and gases.*—If a piece of cork be pushed down into water, little air-bubbles are seen sticking to it. When a lump of sugar is dropped into a cup of tea, the atmosphere of air which surrounds the particles does not quit them till they are dissolved; bubbles are seen rising till all the sugar has disappeared.

6. **Porosity.**—Looking at a piece of cork or of sponge, we see that it is full of little holes; these holes are called *pores*, and the substances having these holes are said to be *porous*. In ordinary language, it is only such substances as cork and very soft woods, in which these little holes are visible, that are said to have pores; but, in reality, all substances are more or less porous. When a piece of bone is examined with a microscope, it appears almost like a pile of empty boxes; and a piece of wood appears like a bundle of pipes. Even the densest solids, as gold and silver, have been proved to be porous. Thus, when a hollow sphere of silver was filled with water, and squeezed with great force, the water oozed through the silver, and stood in drops on the outside of the sphere.

7. **Density.**—This property is very closely connected with porosity: the two are, in fact, the converse of each other, because the more porous a body is, it is the less dense. If we squeeze a body to half its former size, there is of course no less matter in it, but we say we have doubled its *density*, while we have reduced it to half its original *volume;* so that there are in the body after being compressed more atoms (that is, more matter) in the same space than there were before. In comparing the density of different substances, the density of water (distilled) is taken as a standard, and called 1. Measured by this standard, the density of other bodies is called their *Specific Gravity:* thus, the specific gravity of a body whose density is double that of water is said to be 2. Density is a very variable property: it is often increased owing to the *Compressibility* of bodies, and as often lessened by their *Dilatability.* An iron rod when heated becomes both thicker and longer, and contracts again with cold. So much is this the case, that when measurements are being made with an iron rod or chain, if the chain be exposed to great heat or cold, allowance must be made for difference of length. The iron rims of wheels could not be made to fit so tightly, were it not that they are put on when hot. Being a perfect fit when hot, when the iron cools and contracts, the rim binds the wheel very closely. Gases are also highly dilatable. If a bladder be filled almost full of cold air, so as to shew the bladder loose and wrinkled, when heated it is seen to swell out and become quite tight, from the air expanding: on the other hand, many cubic feet of air may be compressed into a single inch.

8. **Elasticity.**—This property is intimately connected with porosity and density. We have seen that bodies are both compressible and dilatable; now, some bodies when compressed have a natural tendency, when the pressure is removed, to expand again to their original volume; such bodies are said to be *elastic*, while those that retain the form given them by the compressing force are called *non-elastic*. Elasticity is not confined, however, to bodies that may be compressed like a piece of sponge, but those bodies are also said to be elastic, which return to the state or position in which they were before the force changing them was applied. A steel spring, when it is bent and then let go, immediately springs back to its former position; so with a piece of india-rubber when stretched. The most elastic of all bodies are gases. The air-gun affords a very good illustration of the elasticity of common air. At the breech of a gun, with an ordinary barrel, is a small hollow sphere, into which air is forced by an instrument for the purpose until it is very much condensed. The opening by which the air is forced in is closed by a valve which opens inward, and when a shot is to be fired, the cock strikes the valve in, allowing a quantity of the condensed air to escape into a chamber behind the ball; and so great is the elasticity of the air, that the ball is projected from the gun with a force almost equal to that of a charge of gunpowder.

9. **Inertia.**—Inertia is the property which bodies have of always remaining in the same state, till that state be changed by external causes. Bodies at rest will remain always at rest, and bodies in motion will remain always in motion, as far as they themselves are concerned; that is, till they be set in motion or stopped by external causes. No proof is required of the fact that when a body is at rest, it will not begin to move of itself; but it is not so clear that when a body is in motion, it will not stop of itself: indeed, many phenomena seem to prove the contrary. However powerfully a stone may be thrown or rolled along the ground, it will at last come to rest. It would thus seem as if it ceased to move of itself; but the truth is, that two very powerful agents are at work to stop it. These are *the resistance of the air* and *friction*. The resistance of the air is far greater than is generally supposed. On putting one's head out of the window of a railway train, the effect experienced is exactly the same as if a gale of wind were blowing. It has been calculated that a 24-pound cannon-ball, when fired with a velocity of 2000 feet per second, experiences a resistance of 800 pounds. The retarding force of friction is greater even than this. We best see its effect by considering what takes place when it is removed. It is well known that a ball will roll much farther, with the same force, on a smooth floor than on a rough piece of ground, and much farther on a sheet of ice than on either. The smoother the surface, then, on which a

body moves, the longer it continues to move. We also know that when a body, a pendulum for example, is set in motion in a place from which the air has been removed, it continues to move for a very long time. It may therefore be inferred, that if friction and the resistance of the air could be removed altogether, a body would, if once set in motion, continue to move for ever.

Forces and Motion.

It has been shewn in the definition of Inertia that a body, whether at rest or in motion, cannot *itself* alter that state. In order to do so, some external cause is necessary. Such a cause is called a *Force*. Force is thus intimately connected with motion; for, if a body be at rest, a force is necessary to set it in motion; and, if it be in motion, a force is necessary to bring it to rest. The principles connecting force and motion have been expressed in three laws, called the LAWS OF MOTION.

First Law of Motion.—The first law of motion is simply a more precise definition of Inertia. *A body will remain either in a state of rest, or in a state of uniform motion in a straight line, unless compelled to change that state by some external force.*

The next consideration that naturally occurs is: How does this change of state depend on the force that produces it? The answer to this question is a statement of the second law of motion, which is as follows:

Second Law of Motion.—*When a body is in motion under the influence of any number of forces, each force produces the same effect as it would if the other forces were not acting.* Suppose a number of forces, P, Q, R, and S, to be acting on a body B; each of these forces, if it were acting by itself, would move the body a certain distance, proportioned to its strength, and in its own direction. Let the lines BA, BC, BD, and BE represent the forces P, Q, R, and S in direction and magnitude. If P alone were acting on the body, it would be moved to A; if, then, Q were to act on it, it would move along AF, parallel to BC, and to a distance from A equal to BC. Let AF be equal to BC; and if, when the body was at F, it were acted upon by R, it would move from F to G, FG being equal and parallel to BD; and so from G to H, GH being equal and parallel to BE. If acted on by the single forces in succession, then, the body would arrive

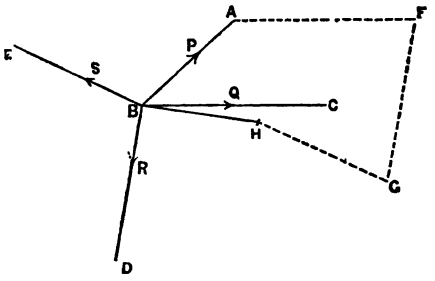


Fig. 1.

at H, moving in the manner described; if they all acted at once, the body would still arrive at H, but only by passing from B to H. A boat being rowed across a river affords a good illustration of this law. If the head of the boat be kept always pointing right across the stream, the passage will be made exactly in the same time as if it had been across a pond of the same breadth; but it will be found that the boat has floated down the stream just as far as it would have done had it been simply floating on the stream for the same time.

In describing the second law of motion, we have spoken only of the effect produced on a body by a force acting upon it; but there is also another effect to be noticed in such cases. If a stone rolled along the ground come in contact with another, the latter will of course be dashed onward, but a change will also take place in the motion of the former; it will either be stopped entirely, or be dashed to one side, or will continue to move in the same direction as before, but with less force. The effect of the rolling stone on the stone at rest is called the *action*, and that of the stone at rest on the rolling one, the *reaction*.

Third Law of Motion.—*To every action there is always an equal and contrary reaction; or, the mutual actions of any two bodies are always equal, and oppositely directed in the same straight line.* If a person in a boat push another boat lying alongside, both boats are moved almost equally from where they were floating, thus shewing that the pushing *reacts* on the one boat as much as it *acts* on the other.

The force with which a body moves is called its *momentum*, and depends on the *weight* of the body, and the *velocity* with which it is moving. A stone when rolled or thrown has greater force than a ball of wood of the same size would have, because the one is heavier than the other; similarly, a large stone has greater force than a smaller one. Instead of *weight*, it is more proper to speak of the *mass* of a body; and in order to understand the meaning of *mass*, it is only necessary to remember the definition of 'density;' for to say that a stone is denser than a piece of wood is the same thing as to say that it has more mass than a piece of wood of the same size. If a single atom of matter were moving at the rate of one foot per second, and if we take this as the measure of momentum, then, in a mass of many atoms, the momentum would be measured by the number of atoms; and if this mass were to move at the rate of 100 feet per second, its velocity would be 100 times the number of atoms greater than that of the single atom. The *momentum* of a body is therefore measured by *the mass multiplied by the velocity.*

The Mechanical Powers.

A machine is an instrument by means of which force is applied to the performance of work, generally by changing the direction of the force—as the capstan, by which sailors raise the anchor; the crane, by which stones or other heavy weights are raised; or the lever, by which a heavy object is moved *upwards* by pressing *down* the other end. Such contrivances do not increase the force applied, but merely afford the means by which it may be directed more advantageously to the end in view. The simple machines used for this purpose, or the MECHANICAL POWERS, as they have been called, are usually considered to be six in number—the Lever, the Wheel and Axle, the Pulley, the Inclined Plane, the Screw, and the Wedge.

I.—The Lever.

A lever, from Latin *levo*, to raise, means *that which raises* or *lifts*. It is a body of any form fixed at a point about which it can move, called *the centre of motion*, or the *fulcrum* [Latin, 'a prop']; thus, when the fire is stirred with a poker, the poker is, for the time being, a lever, and the bar on which it rests is the centre of motion, or fulcrum. Levers are distinguished into three classes.

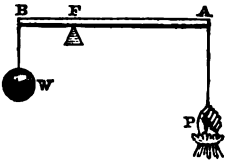


Fig. 2.
AB, the lever; F, the fulcrum; W, the weight; P, the power or force.

(1) The first class of lever (fig. 2) has the fulcrum between the force applied and the weight to be raised, or the resistance to be overcome, as in the case of a poker when stirring the fire. The common balance and a pair of scissors—the latter being double—are both examples of this class of lever.

(2) The second class of lever has the weight between the power and the fulcrum (fig. 3). The common wheelbarrow is a lever of this class; an oar is another example—the man pulling being the power, the water taken hold of by the blade being the fulcrum, and the boat the resistance.

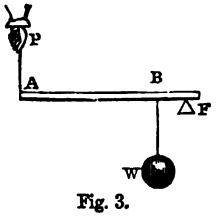


Fig. 3.

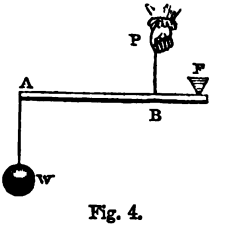


Fig. 4.

(3) The third class of lever has the power between the fulcrum and

the weight (fig. 4). A man pushing open a gate by applying his hand near the hinges, gives an example of a lever of this class; another is furnished by the common fire-tongs, the fulcrum being at the joint, and the lever being double, as in the case of the scissors.

Having now described the different kinds of levers, we proceed to explain the principle upon which they work; and although the practical use of a lever is to *move* a weight, yet, to calculate accurately its manner of working, we must consider it in that state in which the *power balances the weight*, which is called the state of *equilibrium* [Latin, *æquus*, equal, *libra*, a balance]. The whole principle will be understood at once if it be kept in mind that the lever does not, of itself, *give rise* to any force, but merely affords the means of applying it. Let the lever AB (fig. 5), which is three feet long, be supported on the fulcrum F, with two feet of its length on one side, AF, and one foot, FB, on the other; and let a weight of four pounds be suspended at B, and one of two pounds at A. These two weights balance each other—that is, the lever is in equilibrium. But suppose it to move into another position, CD. By a simple proposition in mathematics, we know that AF, being twice as great as FB, the distance AC, through which the small weight moves, is twice as great as BD, the distance through which B moves. We see, then, that the reason why a smaller weight or force is equivalent to a greater weight is, that the smaller force is exerted over a larger space. Thus, when a man wishes to overturn a large stone, and, finding that it is too heavy for him, takes a lever to assist him, he does not get any additional strength from the lever; it merely enables him to concentrate the strength he has. If his strength be sufficient to enable him to press down the end of the lever, the raising power at the other end will be greater exactly in the proportion that the distance through which the one end is pushed down is greater than the distance through which the other end is moved, or in the proportion that the end of the lever next him is longer than the end next the stone. The principle of the lever then is, that the farther from the fulcrum the force is applied, the less it requires to be; and this principle applies to all kinds of levers.

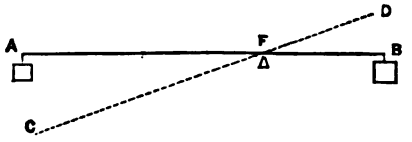


Fig. 5.

Sometimes the object in making use of a lever is not to get a greater power applied, as when a man wishes to raise a stone as described above, but to get greater speed of motion. It will be observed that in fig. 5, the long end of the lever A, since it moves through a distance twice as great as that moved by the short end B, must move twice as fast. If then speed

of motion be desired, it may be gained by means of a lever, *at the expense of a greater force* than is required; and it is to this end that the third kind of lever is applied (see fig. 4). On this principle the foot-board of a turning-lathe is constructed (fig. 6). The fulcrum of the lever is the hinge at the toe of the man's left foot; the power is the man's right foot, which presses down the treadle, thus communicating motion to the string S; and although the power communicated to the string is not so great as that of the pressure of the foot, the velocity is many times greater. Driving nails with a hammer is another example of gain of velocity at the expense of strength or force. The fulcrum is the elbow-joint; the power is exerted by the muscles attached near the wrist; and although the exertion of the muscles is greater than the power communicated to the hammer, yet the velocity gained is very great.

Fig. 6.

The common balance is a familiar application of the lever. Since it is used to weigh quantities of articles *equal* to certain weights, it will be readily understood, from what has been said, that it is absolutely necessary that the arms of the balance be of *equal* length, because a smaller weight at the end of a longer arm would balance a greater weight at the end of a shorter arm. This is one way by which persons selling articles requiring to be weighed could cheat their customers, although their weights were quite correct; for, if one arm of the balance were shorter than the other, by putting the weights at that side, a less quantity than the just weight would balance them.

A few words will now be sufficient to explain the principle of the steelyard, another application of the lever (fig. 7). In the figure, C is the fulcrum or pivot on which it is suspended, CA is the distance from the fulcrum to the point at which the article to be weighed is suspended. The longer arm of the instrument is divided into equal lengths, marked 1, 2, 3, &c.; and the great convenience of this is, that many different quantities can be weighed with one weight. For instance, if the weight used be one pound, and it is required to weigh two pounds, the one-pound weight is placed at the division marked 2, and there, as was seen

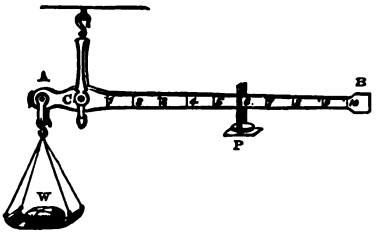


Fig. 7.

in fig. 5, it will balance two pounds in the scale; and so for any other number of pounds, because, if the distance of the small weight from the fulcrum be three, four, or five times greater than the distance of the other weight, that weight must be three, four, or five times greater than the weight at the longer end.

II.—The Wheel and Axle.

This machine, although apparently very different from the lever, is in reality constructed on the same principle. In fig. 8, we see an arrangement by which a small weight, P, balances a much greater one, W. Now, if we

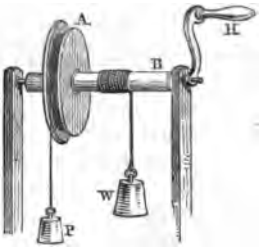


Fig. 8.

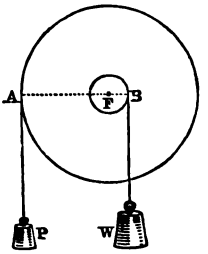


Fig. 9.

take a section of this machine (fig. 9), we see at once how it acts like a lever. Although the machine might be turned round, yet, in every position, the weights act at right angles to the diameters of the wheel and of the axle; and as the machine is perfectly rigid, it is easily seen that it is simply a lever, with F, the centre of the axle, for its fulcrum, and having on one side half the diameter of the wheel, and on the other half the diameter of the axle. If the half-diameter, FA, were six times greater than the half-diameter FB, the weight, P, would balance a weight six times greater than itself. What has been said applies to the machine in a state of equilibrium; for practical purposes, however, the weight on the wheel is not used, the axle being turned by a winch, H (fig. 8). The strength of a man pressing round the handle, acts like the weight on the circumference of the wheel.

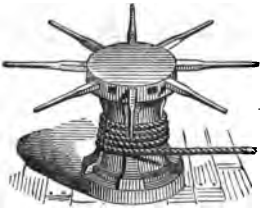


Fig. 10.

The capstan, used on board ships for heaving the anchor, is on the same principle (fig. 10). The fulcrum is the centre of the machine; the short end of the lever, with the heavier weight, is half the diameter of the part round which the

cable is wound; while the longer arm, on which the power acts, is the distance from the centre to the part of the spokes on which the sailors press.

III.—The Pulley.

A pulley consists of a small wheel, with a grooved rim, fixed in a block so as to move freely on its axis, and having a cord passing over the rim, with weights attached to each end. There are two kinds of pulleys, one the fixed pulley, as in fig. 11, the other the movable pulley, as B, fig. 12.

It is clear, that if P is to balance W in fig. 11, the weights must be equal, because the wheel simply acts like a lever with equal arms, as was seen in describing the wheel and axle; so that a fixed pulley does not give any increase of strength, but merely changes the direction of application of the force. For example, if a man wished to raise something heavy to a considerable height, he might find the greatest difficulty in lifting what he could raise with ease by pulling a rope attached to the article over a pulley.

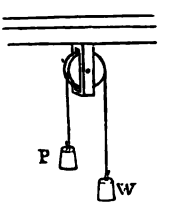


Fig. 11.

By means of a movable pulley, however, as in fig. 12, a man may exert a power greater than his own strength. But, just as in the case of the lever, it is a mistake to suppose that the pulley gives rise to any power in itself; it merely affords the means by which power may be concentrated. The parts of the string in the figure, between A and B, and between B and C, support each one half of the weight of W. And as the effect of C is simply to change the direction of the force, and the tension of the string being the same throughout, it is evident that the hand at P must be pulling with a force equal to half the weight of W. Thus, by means of a movable pulley, a weight or power at the end of a cord is able to balance a weight twice as great. It will readily be seen how it is so. Suppose the cord to be pulled so as to raise W one inch. In order to do this, one inch of cord must be taken up on both sides of the pulley B. The inch on the side of AB will be pulled over the pulley B, and then *two* inches must be pulled over the pulley C; so that, in order to raise W one inch, the hand at P must descend two inches. Thus, exactly as in the case of the lever, although the work done at one end of the machine seems to be greater than that done at the other, it is not really so; for, at the other end, the work is merely spread over a larger space.

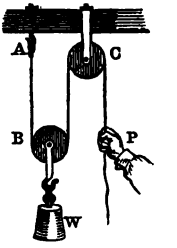


Fig. 12.

IV.—The Inclined Plane.

The Inclined Plane is a contrivance by which a heavy weight can be raised to a height, when it would be difficult or impossible to lift it directly. We have seen, in the case of the Mechanical Powers already considered, that no additional power is actually gained by the use of the machine, or is generated by it, but that its use is simply to enable a small force, when exerted over a larger space, or in a more extended manner, to have the same effect as a greater force applied directly: the same principle applies to the inclined plane. A force pushing a weight from A to B (fig. 13) only raises it through the perpendicular height BD. If, then, AB be twice as long as the height BD, the force necessary to raise any weight from D to B, would, when pushing the weight from A to B, be distributed over twice as much space: but in consequence of this, the force exerted at any moment would be only half as great, leaving out of account the effect of friction, which cannot be taken notice of here. Thus, a power, P, would balance a weight on the plane twice as great; that is, if the mass W weigh two pounds, the weight of P would require to be only one pound. The reason of this is, that part of the weight of W is supported on the plane, so that the resistance of the plane, and the tension of the string, *p*, support the weight of W between them, in the way represented in the figure. The weight of W acts perpendicularly downward from its centre of gravity,[1] *c*, in the direction of *cf*; now, the part of this weight supported by the plane must act perpendicularly to the plane, therefore along *ce*; and the part of it supported by the string, directly opposite to the tension of the string, along *cg*; and these two are independent of each other, so that the proportion of the weight of W to be supported by the string is as *ce* is to *cf*. Now, it is known, according to a simple geometrical problem, that *cg* is

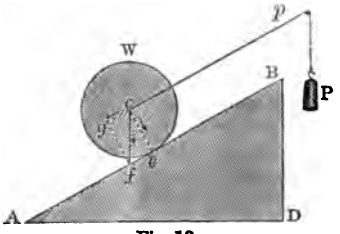


Fig. 13.

Fig. 14.

[1] Centre of gravity is a point in a body such that, if the body be suspended upon that point, it will balance itself in every position.

to *ef* as BD is to AB; therefore, the force necessary to balance a weight on an inclined plane is proportioned to that weight, as the height of the plane is to its length. The degree of slope in an incline is expressed by saying that there is a rise of one foot in so many feet; thus, in fig. 14, where AB is ten times BC, the horse is pulling a load up an incline of one in ten. And, according to what has been said, the draught necessary to be exerted by the horse, if the plane be perfectly smooth, is only one-tenth of the weight of the load. More correctly, a tension of one-tenth the weight of the load would keep the cart from rolling backward; a little more exertion on the part of the horse would be necessary to pull it up.

V.—The Screw.

The Screw is an application of the inclined plane. It is simply an inclined plane passing round a cylinder, as can be shewn by a very simple experiment. If a triangular piece of paper, such as *abf* in fig. 15, be wound round a pencil or ruler, the upper edge of the paper, which is evidently an inclined plane, will form a spiral exactly like a screw, except that a screw is formed by a spiral ridge. This spiral ridge is called the *thread* of the screw, and it works in a *nut* (M, fig. 16), which has a spiral groove to receive the thread, and is turned by means of a lever, L. When the screw is turned once round, it is carried forward in a fixed nut, or it draws forward a movable nut upon it, through the space between two of its threads. The resistance, therefore, has been pulled forward a distance, *eg* or *ga'* (fig. 15); but it has actually passed along the inclined plane *de*, supposing *de* to be the part that would go round the pencil. Therefore, the resistance overcome by the screw is to the force exerted in turning the screw as *de* is to *ec*. A screw, however, seldom acts by itself, being generally turned by a lever, so that, by means of the lever and the screw, a man is often able to overcome a resistance more than a hundred times greater than the force he applies to the lever.

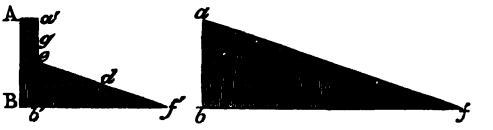


Fig. 15.

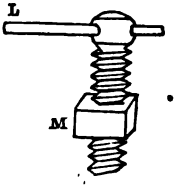


Fig. 16.

VI.—The Wedge.

The Wedge (fig. 17) is a contrivance for separating or overcoming resistances by being forced in between them, and is really a combination

of two inclined planes, the height of each being half the thickness of the back of the wedge. When a wedge is driven into a piece of wood up to the head, the wood at each side is forced back as far as half the thickness of the head. This has been done gradually by the sides of the split being forced up the inclined planes formed by the sides of the wedge. Now, as a certain force balances a greater resistance on an inclined plane the longer the plane is, it follows that the longer the wedge used the greater is the power gained by using it, whether in splitting an object, or in raising a weight.

Fig. 17.

Ships are raised in docks by driving wedges under the keel. Cutting and piercing instruments, as the plough, all act on the principle of the wedge. A familiar illustration of the principle is seen in the case of one glass tumbler placed within another, very little pressure on the uppermost one being sufficient to burst the lower.

HYDROSTATICS.

We have seen (COHESION, p. 3) that all matter exists in one or other of the three states, solid, liquid, and gaseous. Liquids and gases have a general resemblance to each other in this respect, that their particles seem at liberty to glide about among one another without friction: they *flow*, and have hence received the common name of *fluids*, from Latin *fluo*, to flow. All liquids and gases have a certain degree of fluidity; but the property which chiefly distinguishes them is *elasticity*. A quantity of gas may be compressed into much less than its ordinary bulk, and when the pressure is removed it will return to its original volume; but no *ordinary* pressure produces any sensible compression on water or any other liquid. Liquids are thus practically incompressible, and therefore practically inelastic. The phenomena of liquids are of two kinds, corresponding to those of solids—the phenomena of liquids *at rest*, or in equilibrium, and the phenomena of liquids *in motion*. The department of Physics which treats of liquids *at rest* is called HYDROSTATICS, from Greek *hydor*, water, and *statikē*, at rest. A few of the facts or laws in connection with this subject are now to be considered.

1. The fundamental principle of hydrostatics is, that *when pressure is exerted on any part of the surface of a liquid, that pressure is transmitted to all parts of the liquid, and is exerted equally in all directions.* That it must be so is evident from the nature of a fluid, whose particles are perfectly movable among one another, so that any particle could never be at rest unless when equally pressed on all sides. The first inference from this is, that *the pressure of a liquid on any surface is*

proportional to the area of that surface. Suppose the box B to be filled with water, and to have a number of openings of the same size, as *a* and *b*, with pistons or plugs exactly fitting them; and, for greater simplicity, suppose the water to be without weight, so that we may consider merely pressure arising from the forcing down of the plug. If the piston at *a* be pressed in with a certain force—say, equal to a weight of one pound—this pressure will be transmitted to all parts of the vessel (because the particles of the liquid could not be at rest unless there was an equal pressure throughout), and thus to the piston at *b*. And since the piston is of the same size as that at *a*, the pressure on it is the same as the reaction of the water on the piston at *a;* in other words, there is a pressure of one pound on it. The pressure on the two, then, is two pounds, and both being equal in size, the area of the two is twice that of one of them. If there were a large piston, *c*—say, four times as large as *a*—the pressure on it would be four pounds. If a piston, one square inch in area, were pressed into a vessel full of water with a force of one pound, and if the area of one of the sides of the vessel were one foot, then the pressure of the water on that side would be 144 pounds.

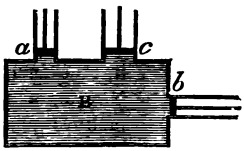


Fig. 18.

On this principle there has been constructed a very useful and powerful machine, named the Hydraulic Press, which is also called Bramah's Press, from the name of the inventor. The figure (19) shews the essential parts of the machine. H is a force-pump by which water is forced from the tank T, through the tube G, to F, the cavity of a strong cylinder, E. D is a piston which passes water-tight through the top of E, and is pressed upward by the pressure communicated to the water by the piston of the force-pump H. On the top of D is a plate, on which are placed the articles to be pressed, C; and the rising of the plate, caused by D being forced upward by the water, presses these against another plate, AA. It is very easy to calculate the pressure communicated to D; for, according to the law stated above, the pressure caused by the piston of H is to the pressure on D as the area of the piston is to the area of the end of D. If the area of the end of D were 1000 times greater than that of the piston of H, and the piston of H were pressed down with a force of 500 pounds,

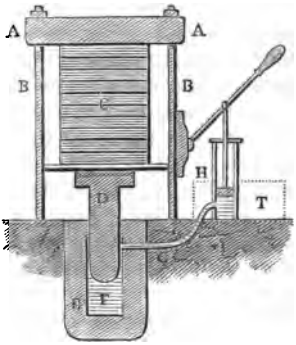


Fig. 19.

the pressure on D, and through D on the articles between the two plates of the press, would be 500,000 pounds, or above 200 tons.

The pressure caused by a piston being forced into a vessel filled with water, may also be caused by the weight of water itself; for whether the piston at *a* (fig. 18) be forced in with a pressure of one pound, or one pound-weight of water stand in the tube, the pressure in both cases is the same. In this way a very strong cask may be burst by a few ounces of water. In fig. 20, *a* is a cask filled with water, and *b* is a very narrow tube inserted in the top of the cask. If the tube hold only half a pound of water, and the bore of the tube be one-fortieth of a square inch, the pressure of the water in the tube will cause a pressure, transmitted by the water in the cask, of half a pound on every one-fortieth of an inch of the inner surface of the cask—that is, of nearly 3000 pounds on every square foot—a pressure which no ordinary cask could bear.

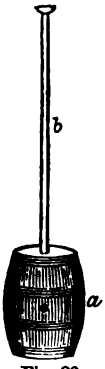


Fig. 20.

This bursting of the cask is an illustration, on a small scale, of the simple means by which the operations of nature are effected. For example, the water poured into a crevice in a rock by successive falls of rain will ultimately rise to such a height as to cause a pressure sufficient to burst asunder from the mass a large portion of the rock.

2. *In a liquid mass, there is a pressure increasing in intensity with the perpendicular depth.* The truth of this will be at once clear if we suppose a mass of liquid divided into thin horizontal layers. The upper layer must be supported on the second, and the pressure on the second layer is the weight of the first. And, since the second layer must be supported by the third, the pressure on the third layer is the weight of the two above it; and so on to any depth, the pressure at any depth always being the weight of the water above, so that it must always be proportional to the perpendicular depth. And this is the case whatever may be the shape or width of the vessel. Every one must have noticed with how much greater force water rushes from a deep vessel when the opening is near the bottom, than when it is near the top, or when the vessel is nearly empty: this difference is caused by the difference in the pressure of the water above.

3. *The free surface of a liquid mass in equilibrium is a perfect level.* Since the particles of a liquid are freely movable among one another, it follows that if the liquid were heaped up at any particular part it would always slide down again till the surface was level. There is a case, however, in which the fact is not perfectly clear at first sight—namely, when the vessel consists of different parts communicating with each other. A common tea-pot will afford a convenient illustration. The water stands

in the spout at the same height as in the pot itself; and it must do so, for if the water at B, for instance, were lower than at A, then the pressure under A would be greater than under B, since (§ 2) the pressure is proportional to the depth of the liquid; the water, therefore, could not be at rest, but a flow must take place into the spout, which would continue till the pressure in it was the same as in the pot, that is, till the water stood at the same level.

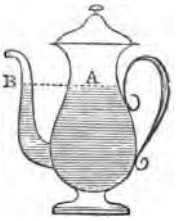


Fig. 21.

This principle is applied to the introduction of water into houses in towns. As fluids always rise to a level, no matter what distance the water may be conveyed by pipes, it will rise to the height of the source from which it is brought.

4. *A solid body, immersed in a liquid, experiences a pressure equal to the weight of the liquid which it displaces, and this pressure acts vertically upwards through the centre of gravity of the liquid displaced.* Let AB be a solid body immersed in water; it is evident that AB occupies the place of a quantity of water equal in volume to itself. Now, suppose AB not yet placed in the water, and AB, as seen in the figure, to be the water about to be displaced; this part of the liquid is supported by the pressure of the rest around. The pressure on the sides has no effect, because it is equal all round, and may therefore be disregarded: it is the pressure from below that properly supports the mass. And since this mass of water has a certain weight which acts at its centre of gravity *g*, the upward pressure keeping it in its place must be equal to that weight, and must act through its centre of gravity. Suppose, now, the solid to be substituted for the water, it must experience exactly the same pressure as acted on the water; that is, the solid AB is acted on by a pressure equal to the weight of the water it displaces, and acting vertically upward through the centre of gravity of the water displaced.

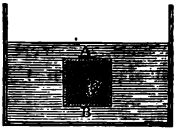


Fig. 22.

It is an obvious corollary from this, that *if a solid be weighed in a liquid, it will be lighter* (than its true weight) *by the weight of a quantity of the liquid equal in volume to the solid.*

This truth was first discovered by the ancient mathematician, Archimedes, and by means of it he was able to discover how much alloy the goldsmith, whom the king of Syracuse had commissioned to make a crown of pure gold, had fraudulently mixed with the metal. It is said that, one day when floating in his bath, it occurred to him that what was supporting his body was that which would support the water displaced by it; and he thought he could, by means of this principle, discover whether

the crown was of pure gold. He is reported to have been so overjoyed at the discovery, that he forgot to dress himself, and rushed through the streets, crying: 'I have found it! I have found it!' To test the crown, he first found the absolute weight of a piece of pure gold, and then its weight when immersed in water. He treated the crown in like manner, and found that it displaced more water in proportion to its weight than the piece of pure gold, which proved that the metal had been mixed with something lighter.

5. *A floating body displaces its own weight of the liquid.* We have seen that, when a body is immersed in water, a pressure equal to the weight of the water displaced acts upon it, pushing it upward, while its own weight tends to make it sink. If, then, these two pressures are equal, the body will rest in any part of the liquid; if the weight of the body is greater than the weight of an equal volume of water, the body will sink to the bottom; while, if the weight of a quantity of water, equal in volume to the body, is greater than the weight of the body, it will be forced upward to the surface. When this last takes place, the body is said to *float.* And, of course, part of it must rise above the surface, because, if it were to rest with its surface exactly level with the surface of the liquid, it might have rested at any part of the liquid; but it is supposed to have been forced upward to the surface. The question, then, comes to be, How much of the body will rise above the surface? or, which is the same thing, How much of it will be in the water? We have seen that a body, immersed in a liquid, remains *at rest* when the weight of a quantity of the liquid equal in volume to itself, is equal to its own weight; and from this it is clear that a floating body (as AB) will be at rest, when the weight of the water displaced by the submerged part B is exactly equal to the weight of the body. Thus the heaviest bodies can be made to float on a liquid, if only they can be so arranged as to displace a quantity of the liquid of weight greater than their own. A piece of iron sinks in water, but ships can be made of iron, because they are hollow, and displace a quantity of water of greater weight than their own.

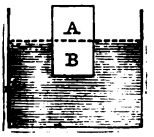


Fig. 23.

ACOUSTICS.

ACOUSTICS[1] is the science which treats of *sound*. Sound is the sensation produced when the vibrations of some sounding body are conveyed directly or indirectly to the organ of hearing. That a body producing sound is in a state of vibration at the time is seen in any stringed musical instrument, the prongs of a tuning-fork, the lip of a bell, &c. These vibrations must be communicated to the ear through some medium connecting the sounding body with the ear, the ordinary medium being the air. This is proved by the fact, that when a bell is struck in a chamber from which the air has been withdrawn, no sound is produced, and that the less dense the air becomes, the fainter are the sounds heard in it, so that on high mountains, where the air is very rare, what would elsewhere be loud talking is heard like whispers. Air, however, is not the only medium, the vibrations being conveyed through water, wood, and other substances. If the head be held under water, any noise at a distance, such as that caused by two stones being knocked against each other, is heard with great distinctness. Or if the ear be placed at one end of a log of wood, the slightest scratch at the other end is heard very distinctly, the vibrations being transmitted through the particles of the wood. Bodies denser than air are better conductors of sound, but, as air is the ordinary medium, the general principles of sound have reference to it. Vibrations are the wave-like motion which is communicated to the air by any shock, such as a shot, the blow of a hammer, or an explosion. The air is not made to change its place, but the compression of its particles caused by the shock is passed along like the undulations of a rope held at one end and moved up and down. These undulations pass outward from the body producing them, in all directions, exactly like those caused on the surface of water by a stone thrown into it, and, like them too, they diminish in force as they proceed outward.

Loudness of Sound.—The loudness of any sound depends upon the force of the concussion of the air, and the force with which this concussion is conveyed to the ear; so that, from the decreasing force of the sound-waves, in a certain ratio, the intensity or *loudness* of sound diminishes with the distance of the hearer from the object causing it. But a great many other things besides the distance have to be taken into account as affecting the intensity of sound. Thus, sounds at a distance are heard much better at one time than another: this arises from various causes. As was mentioned above, the denser the air is the better are sounds heard; a dense state of the atmosphere would therefore account for sounds being heard

[1] From Greek *akoustikos*, relating to hearing or sound, from *akouō*, to hear.

distinctly at a great distance at a particular time. Sounds are also better heard in a dry atmosphere, as moisture seems to interfere with the propagation of sound-waves. Although a simple current of air does not of itself produce sound (it only does so when it comes in contact with obstacles in its way, as trees, houses, &c., by which vibrations are produced), yet it will carry sound-waves in any direction; sounds are therefore heard more distinctly when there is a breeze blowing from the source of the sound towards the hearer.

Velocity of Sound.—The velocity with which sound-waves are propagated can be calculated very exactly, owing to the extreme rapidity with which light travels. The velocity of light is so great that for any distance within the limits to which sound could be heard, its passage may be considered as instantaneous. This being the case, the blow, shot, explosion, &c. causing any noise, may be *seen* to take place before the noise is heard; and the time that elapses between seeing the cause and hearing the noise is the time that it takes for the propagation of the sound-waves to the distance of the hearer. If a man be observed at a distance striking heavy blows on anything, the blow will be seen to descend some time before the sound of it is heard; so with the firing of a gun, the flash is seen before the report is heard. It has been found by experiment that sound travels at the rate of about 1142 feet per second, or of a mile in about four seconds and a half. The velocity is somewhat less, however, when the temperature is lower, being only 1090 feet at the freezing-point. In water, sound travels about four times, and in solids, from ten to twenty times more quickly than in air.

Reflection of Sound—Echo.—We are now to consider what takes place when a sound-wave meets a large obstacle to its progress. The vibration is to a small degree communicated to the solid, just as light is transmitted through a new medium; but the principal effect is to reflect the wave, just as a wave of the sea is thrown back from a rock. When a sound-wave is thrown back in this way from a flat surface, the sound is carried back to the point where it was produced, and this return-sound is called an *echo*. It may be produced by a perpendicular wall of rock, a wood, or other obstacle. If a sound be produced between two faces of rock, for instance, it will first be echoed by both; and then those echoed sounds (the sound being now doubled) will be thrown back from one to the other again and again, becoming fainter each time; so much so, that a shot in such a situation may be repeated forty or fifty times. The best echo is produced by a concave surface, such as the roof of a cave, by which the sound-wave is reflected to a *focus*, as in the case of rays of light. If one happen to stand so as to bring one's ear into the focus, the whole of the sound, concentrated at that point, falls upon the ear, and the effect is astounding.

The ears of animals are admirably adapted to receive impressions from the vibrations of the air caused by so-called sounding bodies. The external ear collects part of the sound-wave, and turns it into the passage which conducts it to the membrane from which the vibrations are conveyed to the auditory nerves. The *ear-trumpet*, which is a trumpet-shaped instrument, having a wide mouth at the end of a tube, is simply a contrivance by which a greater volume of the sound-wave is collected and conveyed into the ear.

Musical Notes.—We have hitherto spoken only of a single shock transmitted through the atmosphere as producing a single sound. The sensation conveyed to the ear when blows are struck with a hammer is a succession of distinct sounds. When sounds are produced in such quick succession that the successive pulses of the air cannot be distinguished by the ear, a musical *note* is produced. For example, if a toothed-wheel, with a plate of some thin elastic substance resting on the teeth, be turned slowly, the shock produced by the plate falling off each tooth is conveyed separately to the ear, and separate sounds are heard; but when it is turned more rapidly, the shocks all blend into one, and the sound heard is a continued 'whir;' and the more rapidly the wheel is turned the more sharp and shrill the 'whir' becomes. It is on this principle that notes are produced from the strings of musical instruments. When a string stretched between two objects is pulled aside in the middle, its elasticity causes it to return to its proper position; but the momentum it has meantime acquired carries it past to about the same distance on the other side. Its elasticity here comes into play again, and it is again carried past the middle straight position almost as far as it was pulled aside at first: the same thing is repeated; and this goes on, the vibrations on each side gradually becoming less and less, till the string at last comes to rest. When this is done with a slack string, the vibrations are slow; but when the string is tight, the vibrations are so quick that, as in the case of the toothed-wheel when turned rapidly, the separate pulses are blended into a continuous note; and the tighter the string is pulled, the sharper is the sound produced by its vibrations. A good illustration of successive vibrations blending to cause a continuous sound, is the 'buzz' of a fly, which is supposed to be not the voice of the insect, but the sound produced by the rapid vibrations of its wings. It is on this rapidity of vibration that the difference of sounds depends. We observed that the 'whir' of a toothed-wheel striking an elastic plate becomes more shrill the quicker the wheel is turned, and that the sound produced by a vibrating string is sharper the quicker the vibrations are made. Now, a short string will evidently vibrate more quickly than a long one; therefore, every degree of sharpness of sound can be produced from strings by making them of different lengths and of

different tightness. A string half the length of another, and of the same tension, vibrates twice as quickly, and the musical note produced by it has a fixed relation to that produced by the other. From this it will be understood why a fiddler places his fingers up and down on the strings as he plays. The string can only vibrate as far as the point on which he places his finger; by putting his finger on the string a good way up, he shortens the string, and a sharper sound is produced; thus, besides having the range of the four strings, which give different notes from being stretched to a different tightness (the bass-string being also loaded with copper wire, to make it vibrate more slowly), he has a range of notes on each string, by means of shortening them to different lengths.

Different notes are also obtained from pipes, according to their length. The sound produced by a pipe is due to the vibrations of the air in the pipe, which are caused by the shock communicated by blowing into it, or partly by the construction of a mouth-piece. The shorter the pipe, the greater is the shrillness of the note produced. Every one knows that the note of a large flute is soft and mellow, while that of a small one is shrill. In an organ, there is a pipe for every note, the different lengths being calculated with extreme care; while in a flute a similar effect is produced by opening and shutting holes along the length of the one pipe. Another system on which musical notes are produced is by placing a slender elastic plate over a slit or opening through which air is made to pass, by blowing, as in the musical toy of this description. The air causes the little pieces of steel to vibrate with great rapidity and thus produce a musical note. The human voice consists simply of musical notes produced by the vibration of two membranes at the top of the windpipe, with their free edges opposite each other, and a slit or opening left between them for the passage of the air by which they are vibrated. When a boy places a blade of grass between his thumbs, and, by blowing on the edge, produces a note by no means musical in one sense, the note is produced exactly on the principle of the human voice as produced by the larynx, being caused by the extremely rapid vibrations of the edge of the blade of grass. The voices of children and women are shriller than those of men, because the membranes of the larynx are shorter in the former than in the latter, and thus produce sharper notes.

OPTICS.

The subjects treated of in the science of OPTICS[1] are Light and Vision. We learned in the chapter on ACOUSTICS, that the sensations of Sound are produced by vibrations in sounding bodies being communicated to the air, and by it transmitted to the nerves of the ears. It is now believed that both Light and Heat consist of a vibratory motion of the particles of light-giving and hot bodies, and that they are transmitted in a manner exactly similar to the transmission of sound. The medium, however, cannot be the air, since light and heat pass where there is no air; philosophers have accordingly come to the conclusion that all space is occupied by an infinitely elastic substance or fluid called *ether*. The vibrations of the particles of a luminous body are communicated to the ether; the pulses transmitted through it enter the eye, and strike upon the retina, and, being thence conveyed to the brain, produce the sensation of Sight. These vibrations pass from a luminous body in every direction, and for this reason Light is said to be composed of *rays*, from Latin *radius*, the spoke of a wheel, and these rays are said to be *divergent*. Light travels at the rate of about 194,000 miles in a second.

When light falls on the surfaces of bodies, some or all of the rays are *reflected*, or thrown back by the surface; or, some or all of the rays are *transmitted*, or pass through the body, according to the nature of the body, and the manner in which the light falls upon it. Rays which are transmitted from one substance into another, are bent out of the straight line, and are said to be *refracted*. The following lessons on Optics consist of a short statement of the Laws of Reflection and Refraction.

Reflection.

Let AB (fig. 24) be a reflecting surface, as a mirror, with a ray of light falling on it in the direction of *ed;* and let *cd* be a line perpendicular to AB: then, by the first law of reflection, the ray *ed* will be reflected from AB in the direction *db*, so that *ed*, *dc*, and *db* shall all be in the same plane; and by the second, the angle *cdb* is equal to the angle *cde*. A ray *falling on* a surface, as *ed*, is called the *incident*[2] ray, and *d* is called the point of *incidence; cd*, the perpendicular at the point of incidence, is called the *normal;* and *db*, the *reflected* ray. The first law of reflection may

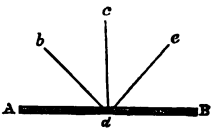


Fig. 24.

[1] From Greek *optikos*, relating to sight. [2] From Latin *incido*, to fall upon.

now be stated thus—*The incident ray, the normal, and the reflected ray are all in one plane.* Again, *edc* is called the angle of incidence, and *cdb* the angle of reflection; and the second law of reflection is—*The angle of reflection is equal to the angle of incidence.* Two other facts will now be easily understood.

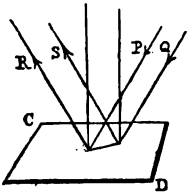


Fig. 25.

1. Rays of light that fall on a reflecting surface parallel to each, will be reflected parallel to each other. Rays being reflected from a surface *at the same angle* as they fall upon it, it is evident that after reflection they must remain parallel. If P and Q (fig. 25) are parallel when they fall on CD, R and S will also be parallel.

2. When *divergent*[1] rays, or rays that spread out from a point, fall on a mirror, the point from which the reflected rays *seem to proceed*, is on the opposite side of the mirror, and at a distance equal to the distance of the point from which the rays actually proceed. Thus, let rays, diverging from the point Q (fig. 26), fall on a mirror at A and B, and be reflected in the direction of R and S; the point *q*, from which they seem to proceed, is on the opposite side of the mirror, and the distance N*q* is equal to the distance NQ.

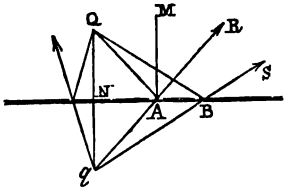


Fig. 26.

Refraction.

The body or substance through which light passes is called a *medium*. When light passes from one medium into another, it is *refracted* or bent out of its straight course. This is seen by a very simple experiment. Let a coin be placed in the bottom of a basin so that it is just out of sight. If water be poured into the basin without moving the coin, it will gradually come into sight, the cause being, that the light from the coin is bent out of the straight line in passing from the water into the air, so that the light that comes from *a*, along *a*DC, seems to come straight from *b*, and the coin seems to be raised up.

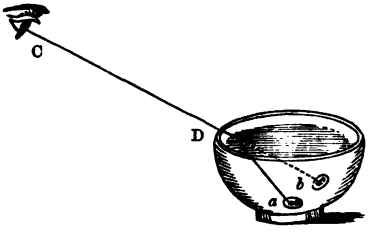


Fig. 27.

[1] From Latin *dis*, asunder, and *vergo*, to incline.

Another example of the same thing is the bent appearance of a stick when held partly in water, the explanation being, that the light from every part of the stick under water is refracted, so that it seems to be raised up, as was the case with the coin. So, too, objects at the bottom of a clear stream or pond appear to be raised up, and the water seems less deep than it really is. The principle on which these phenomena take place is, that light when passing from a *rarer* to a *denser* medium (for example, water and glass are *denser* than air, and air is said to be *rarer* than water or glass) is refracted *towards* the perpendicular; and on passing from a denser into a rarer, is refracted *from* the perpendicular; and this in proportion to the relative velocity with which light passes through the different media. Thus, suppose a ray of light to pass through a piece of glass: on entering the glass, it is turned towards the perpendicular to a certain extent; but on leaving the glass and entering the air again, it will be refracted from the perpendicular; and as this must be exactly to the same extent as it was turned towards it on entering the glass, it is clear that the ray, on emerging from the glass, will proceed in the same direction as it was doing before it entered.

Having hitherto treated of media with parallel surfaces, we will now consider the case of a medium the surfaces of which are not parallel but are supposed to meet. A medium of this form is called a *prism*, as BAC, and the angle at which the surfaces meet, as A, is called the *vertex*.[1] A ray of light transmitted through a prism, of any substance denser than the surrounding medium, is always refracted *from the vertex*. Let a ray, SP, fall on the transparent prism BAC at P; let *nn'* and *mn'* be the perpendiculars to the two surfaces. On first entering the new medium, the ray will be refracted from its straight course, SD, towards the perpendicular, into the direction of PQ, say. Now, at first sight, it might be expected that, on emerging into the air again, it would proceed in a direction nearly the same as before entering the prism, that is, turn towards the vertex of the prism; but it is clear, from the construction of the figure, that the ray must emerge on the opposite side, that is, turn away from the vertex along QR. It would be the same, although the incident ray were on the side of the perpendicular next to the vertex; because the refracted ray *in the prism* must always be on the side of the perpendicular next the vertex, and must therefore always emerge on the opposite side, away from the vertex.

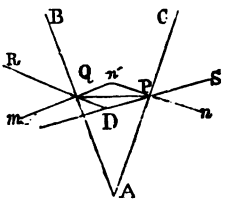


Fig. 28.

All the effects produced on light by passing through different lenses

[1] Latin *vertex*, the top or *turning* point, from *verto*, to turn.

will now be easily understood, especially if the general principle with regard to prisms be kept in mind, that rays of light transmitted through them are always refracted towards the thick part, because most lenses are simply *double prisms*. Thus, take the double-convex and the double-concave lenses—1 and 4 in the figure: the first is as if two prisms were fixed together with their vertices turned outward, and the second the same, only with the vertices of the prisms meeting in the middle. When a ray of light, as RI, fig. 30, falls on a convex surface, as AVB, the perpendicular (or *normal*) at that point, NIC, is the perpendicular to the tangent-plane; and the ray being refracted towards the perpendicular, as IF, is therefore turned towards C, the centre of the curve of the surface. Now, if a ray fall on any other point of AV, since the normal must always be the line from that point to C, and the ray must be refracted towards the normal, it must also be turned towards C; and so for all rays that fall on AV. In the same manner, all rays that fall on VB would be turned towards C, because they must all be refracted towards the normal at every point, and the normal must always point to C. The effect of the whole surface, AB, then, is to draw rays of light that fall on it together, to a point behind the surface. Rays which draw together in this way are said to *converge*. This is the effect produced by rays of light which fall on the transparent *cornea* of the eye; they are made to converge and pass through the pupil; at least, by means of it, more rays pass through it than if there had been no refracting medium in front of the iris. (HUMAN PHYSIOLOGY, page 73.) This being the effect of one convex surface, it is very much greater when there are two together, as in a double-convex lens, fig. 31, which will be at once clear from what was said of the prism. The effect of the prism was seen to be to cause a double refraction towards the thick side; now, one side of a double-convex lens, as PAB, is equivalent to a number of prisms all turned one way, because at every point of the curved

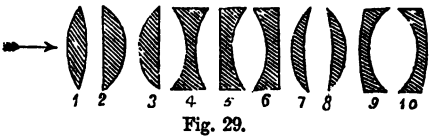


Fig. 29.

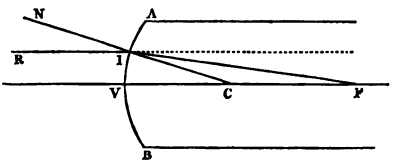


Fig. 30.

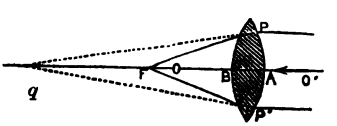


Fig. 31.

surface we might suppose the plane face of a prism. Also the other half, as P′AB, is equivalent to a number of prisms all turned the other way; so that the whole effect of a double-convex lens, as PP′, is to cause a double refraction of all rays that are transmitted through it *inwards*. Thus, suppose a number of parallel rays to fall on the lens PP′; let one fall at P; then at the first surface it is refracted into the direction P*q*, and if not further interfered with, it would meet the axis at *q* (corresponding to F in fig. 30), but at the second surface it is again refracted, and thrown more towards the thick part of the lens, so that it meets the axis at F. Again, of those that fall on the other side, let one fall at P′; it is refracted at the first surface into the direction P′*q*, and then at the second it is also turned to F. This is what takes place in the eye, when the light that enters by the pupil is transmitted through the *crystalline lens*. (HUMAN PHYSIOLOGY, page 74.) The point, F, at which the rays of light meet the axis or middle line O′*q* (for they all meet it at one point), is called the *focus*. In the eye this focus falls on the retina, and the cause of defective eyesight is simply that the rays of light are brought to a focus, not on the retina, but either in front of or behind it. In the former case, the individual is said to be *short*-sighted or *near*-sighted, and in the latter, *far*-sighted. The principle on which spectacles help to remedy those defects will be explained presently. After what has been said of a convex surface and the convex lens, it needs no proof to shew that the effect of a concave surface and of a double-concave lens (fig. 29) is exactly the reverse. As the normals to a concave surface all meet in the centre of the curve *outside* the body, inside they all *diverge;* and therefore parallel rays of light transmitted through a medium with a concave surface meeting them, being all refracted towards the normals, must all be made to diverge also. Then as to a double-concave lens, if we suppose it to be the same as two prisms with their thick part outwards, it is at once clear that all rays transmitted through it must suffer a double refraction outwards, that is, be made to diverge.

A very few words will now make the principle of spectacles perfectly intelligible. In the case of a near-sighted person, the defect in his sight is that rays of light are brought to a focus *in front of* the retina, the cornea and crystalline lens making the rays converge too much. To remedy this, it is necessary to make the rays *diverge* a little before entering the eye. This we saw to be done by a double-concave lens; therefore, near-sighted persons often wear spectacles with double-concave lenses. The defect in the case of far-sighted persons is that light is brought to a focus *behind* the retina: the refracting power of the cornea and crystalline lens is not strong enough, and it is necessary to make the rays converge. This, as we saw, is the effect of a convex lens; therefore, far-sighted people wear spectacles with double-convex lenses.

ELECTRICITY.

ELECTRICITY received its name from the Greek word *ēlektron*, amber, in which substance it was first detected. It was found, from the earliest times, that when a piece of amber was rubbed with a dry cloth, it had the power of attracting small light bodies lying near it. In later times, it was observed by scientific men that sulphur, glass, sealing-wax, and many other substances had the same property; and now-a-days electric experiments are all made with these common substances, instead of the comparatively rare and costly amber, especially since they exhibit the phenomena of electricity in as great perfection as the substance in which it was first discovered.

In order to observe better what takes place, let us suspend something very light—a little ball of pith of the elder-tree is generally used—by a silk thread from a glass tube, as in the figure (the reason why glass and silk are used will be explained afterwards). If a glass tube be rubbed with a piece of dry silk, and then held near the pith-ball, the latter will at first be drawn to the glass, and then be driven away, as indicated in the figure. If a stick of sealing-wax be taken next, rubbed with a piece of flannel, and held to the ball, which has just been repelled by the glass, the same thing will take place—the ball will first be attracted, and then repelled. If the glass be rubbed again, the same thing may be repeated of course; so with the wax; and the pith-ball might thus be kept playing between the two for any length of time. There are thus two kinds of electricity, one produced in glass when rubbed with a piece of silk; and the other in sealing-wax when rubbed with a woollen cloth. When the electrified glass attracts the pith-ball, electricity is communicated to the ball, and then it is repelled; in other words, two bodies charged with the same kind of electricity repel each other. Then the ball is attracted by the wax, and is only repelled again when the electricity received from the glass has been replaced by the kind produced in the wax; and we infer from this that two bodies charged with the different kinds of electricity attract each other. Special names have been given to these two kinds of electricity: the kind produced in glass and a number of other substances is called *vitreous*, from Latin *vitrum*, glass; while that produced in sealing-wax and a number of other substances of a resinous nature is called *resinous*.

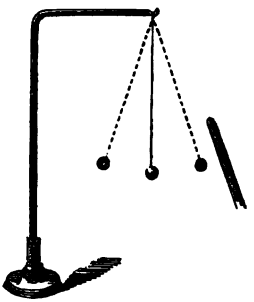


Fig. 32.

Instead of these two names, however, *positive* and *negative* are now more frequently used; and for convenience, the algebraic signs corresponding to these are employed, + and −. The sum of what has been said may now be stated thus: *Bodies charged with either positive or negative electricity attract bodies charged with negative and positive electricity respectively, and attract bodies not electrified at all; but they repel all bodies charged with electricity of the same kind as their own; further, electricity can be communicated by contact from one body to another.*

In the above experiment, a particular substance is rubbed with a particular kind of cloth, the glass with silk, and the sealing-wax with a woollen cloth. When electricity is produced in a substance by friction, electricity of the opposite kind is produced in the rubber or substance (a cloth generally) with which it is rubbed; and a body, which becomes charged with positive electricity when rubbed with one substance, may become charged with negative when rubbed with another. Thus, when glass is rubbed with silk, the electricity of the former is positive, and that of the latter, negative; but if the glass be rubbed with a cat's fur instead of silk, the electricity of the former is negative, and that of the latter, positive. In the following list, each body, when rubbed with the one before it in order, becomes charged with negative electricity; when with the one coming after it, with positive—cat's fur, glass, linen, feathers, wood, paper, silk, shell-lac, ground glass.

It must be remembered that all bodies do not become charged with electricity when rubbed; those that do are called *electrics*, and those that do not, *non-electrics*. There is another distinction to be noticed in bodies, and that is with regard to receiving the electricity which has been produced in an electric; those that do are called *conductors*, and those that do not, *non-conductors*. Most bodies are electrics, but it makes a material difference in this respect whether the body be a conductor or not; because, if the electric be also a conductor, the electricity produced is immediately carried off; while, if it be a non-conductor, the electricity remains on the surface, and is more apparent. Thus it happens that practically the most powerful electrics are non-conductors. The most important class of conductors are the metals. Water is also a good conductor. A few of the principal non-conductors, and thus, in a certain sense, the best electrics, are shell-lac, caoutchouc, amber, resin, sulphur, wax, glass, gems, silk, wool, hair, dry paper, leather, camphor, chalk, lime.

We can now explain why the pith-ball, made use of in the experiment, was suspended by a *silk* thread from a *glass* stand. Glass and silk are non-conductors, and so the electricity communicated to the pith-ball could not be conveyed away by these substances, as it would have been if it had been attached to a conductor; as, for instance, if it had been fastened by a

wire to an iron stand. A conductor cut off from communication with the ground by being fixed on non-conductors, in this way, is said to be *insulated.*

Let us now return to our first experiment. We saw by it that positive electricity attracted negative, and negative, positive; and also that *both attracted bodies not electrified at all:* it will now be shewn that the last part of this statement is the same as the first. If a brass cylinder be fixed on a glass stand, with a pair of pith-balls suspended by a cotton thread (not silk this time, because it is not desired to insulate them from the cylinder), at either end, and placed near another insulated conductor charged with positive electricity, this is what will happen—the balls will be repelled from each other, as in the figure, shewing that each pair has become charged with the same kind of electricity. But it is found that the electricity at the two ends is of different kinds, that in the end next the ball being negative, while that in the other end is positive. This is quite in accordance with the result of our first experiment, that positive electricity attracts negative, and repels positive, and *vice versâ.* From this it is manifest, that in all conductors there exist (without friction) the two kinds of electricity, and that these are acted upon by an electrified conductor exactly in the same way as if the electricity had been produced by friction in both. It will now be seen that, when the rubbed glass attracts the pith-ball the first time, the attraction is not different from the subsequent attractions; the positive electricity in the glass repels the positive in the ball to the opposite side, and attracts the negative. This attraction is great enough to overcome the slight weight of the ball; when contact takes place, the negative electricity in the side of the ball next the glass is replaced by positive electricity from the glass. The ball is then charged altogether with positive electricity, and of course is now repelled by the glass; but at the other side, the sealing-wax which is charged with negative electricity attracts it; and so on. The influence which an electrified conductor thus exercises on a non-electrified one is called *Induction.*

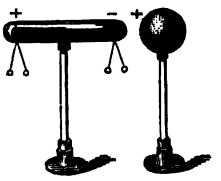


Fig. 33.

Lightning.

In the case of the pith-ball, when induction takes place, owing to its lightness and the manner in which it is suspended, it comes in contact with the glass, and electricity thus passes to it from the glass; but if, in fig. 33, there were a sufficient quantity of electricity in the ball, and the attraction were great enough, it would pass to the cylinder without contact; and there would be a slight flash of fire and a slight crack. Now, this flash

and this crack are lightning and thunder in miniature, for the black thunder-clouds that we see in a thunder-storm are clouds charged with electricity. When two thunder-clouds approach each other, induction takes place, and owing to the immense quantity of electricity the two contain, when it passes from the one to the other, the flash is of exceeding brightness, and the report deafening. Sometimes the induction takes place between a cloud and a prominent object on the ground, such as a steeple, a tall chimney, a tree, or an animal. Anything will do, if it form a point near enough the cloud to cause the electricity to overcome the resistance of the intermediate space; and the consequences are generally fatal to the object in this position. But it is not necessarily so; the destructive effects of lightning, or of electricity rather, only take place when it meets with resistance—that is, when induction takes place between a thunder-cloud and some object which is a bad conductor of electricity. Hence the object of lightning-conductors. Metals being good conductors, if a rod of metal have its point extending beyond the top of any prominent object, and pass down into the ground, when a thunder-cloud happens to be near, and induction takes place, the electricity, which would otherwise have shivered the non-conducting steeple or chimney, passes harmlessly down the metal rod.

It may now be asked where this vast quantity of electricity in the thunder-cloud comes from. We saw that electricity is produced by friction; this, in the case of the thunder-cloud, is one source of it, for there are many different kinds of friction going on in nature. The friction produced by the wind in various ways is very great; thus electricity may be produced in a piece of glass by a blast of air from a bellows, instead of by rubbing. But, besides friction and all other forms of mechanical action, electricity is produced by all kinds of physical and chemical action; it is produced by the great system of evaporation which is continually going on from all bodies of water, and also from the processes of vegetation in which water is being continually separated and evaporated from plants, so that the vapours and gases that rise into the air are all more or less charged with electricity; and this electricity, which is generally diffused through the atmosphere, becomes occasionally concentrated in clouds, and is then liberated in the form of lightning.

The Electric Telegraph.

In the form of lightning, electricity is often very destructive, and is at all times very terrible; but the reason and skill of man have enabled him to turn it to account in a most useful manner. By means of the electric telegraph, a message can now be sent half round the world in a few hours.

We have said that one of the sources of electricity is chemical action;

electricity produced in this way is called Galvanism,[1] or Voltaic[2] Electricity. When two plates, one of copper, and the other of zinc rubbed over with mercury, are placed in contact in a vessel of water in which is a little sulphuric acid, bubbles of gas are formed; and when the plates are removed, the zinc one is found to have lost in weight, the part it has lost being dissolved in the water. The same action takes place, although the plates are not in contact, if they are joined by a copper wire, as in the figure. In consequence of this chemical action, it is found that a current of electricity passes along the wire from the copper plate, in which positive electricity is produced, to the zinc, in which negative is produced. Further, under the liquid, a current passes from the zinc plate to the copper; so that by means of the wire and the liquid, the electricity makes a complete circuit; and such an arrangement receives the name of a galvanic or voltaic *circuit*. By employing a number of plates, the zinc ones being connected with the copper ones in a series, the strength of the current is of course increased, and such an arrangement is called a *galvanic battery*.

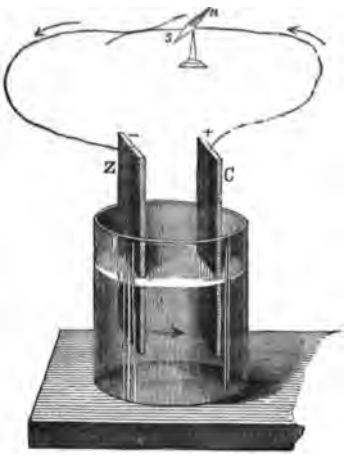


Fig. 34.

For the proper understanding of what is to follow, it will be necessary to give here a short description of magnets. There is a certain ore of iron which has the power of attracting iron. It was first found in Magnesia or Lydia, in Asia Minor; hence a piece of this ore was called a *Magnet*, or Lydian-stone, which last name (probably from the power of the ore to *lead* or attract things) became changed into *loadstone*. When a small magnetic bar is nicely balanced on a fine point, it is called a magnetic needle, and has the remarkable property of always pointing north and south, being of course free to move.[3] Such a piece of ore is called a natural magnet. An artificial magnet can be

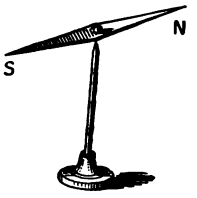


Fig. 35.

[1] So called from *Galvani* of Bologna, its discoverer.

[2] Voltaic Electricity, or Voltaism, so called from *Volta*, an Italian.

[3] The mariner's compass consists simply of a needle of this kind, balanced in the centre of a ular box, on the edge of which are letters for the different *points*, N., S., E., W., &c.

made by rubbing a piece of iron with a natural magnet; but the strongest magnets are got by coiling the wire of a galvanic battery round a piece of iron. While the electric current is passing through the wire, the iron becomes strongly magnetic, and ceases to be so as soon as the current is stopped. Magnets are of different forms. Perhaps the most common form is that of the horse-shoe magnet (fig. 36), the object being to bring together the two ends, called the poles, N and S, in which the strength of the magnet is concentrated. The part *sn* is not properly a portion of the magnet, but is a piece of iron, called an *armature*,[1] used partly for convenience, but chiefly for keeping in the magnetism. Fig. 37 shews an electro-magnet, which is a piece of iron that can be rendered magnetic by an electric current, as described above. Neither the horse-shoe nor the armature is magnetic in itself, and therefore they will not remain in

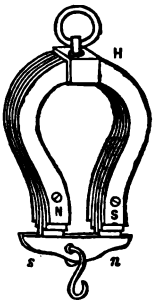


Fig. 36.

Fig. 37.

contact; but as soon as the electric current is sent through the wire coiled round the magnet, the armature is pulled to it with a sharp click. We now proceed to describe the working of the Electric Telegraph.

There is one kind of telegraph which depends on the effect that an electric current has on a magnetic needle placed near it, as in fig. 34, of turning it out of its natural position, in which it points north and south; but as we can only describe one, it will be one on another principle, which is perhaps the best and the one now most extensively adopted, namely, the electro-magnetic. Of this, again, there are various modifications; the instrument here described is Morse's.

We have seen that an electro-magnet is only magnetised when the current is passing, and this can only be when the circuit is complete, as in fig. 34, by the wire and the liquid. Now, everybody knows how the wire of the telegraph passes from one station to another; but how about the

[1] From Latin *armatura*, armour, protection.

other part of the circuit—the part played by the liquid in fig. 34? In the case of the telegraph, the *earth* is substituted for the liquid, for if the wire which goes along the lines be attached to the copper plate of the battery, and a wire, attached to the zinc, be carried down into the earth, the circuit is complete. In fig. 38, then, L is the line-wire, and E the earth-wire, both of which are made continuous with the coils of wire on the electro-magnet, MM′; the armature, A, is attached to a lever, *ll′*, which turns on the axis *k*. Whenever the current is made to pass through the wire, the armature is drawn down, bringing the end of the lever with it; this raises the other end, to which is fixed a sharp point, *p*; opposite this point is a

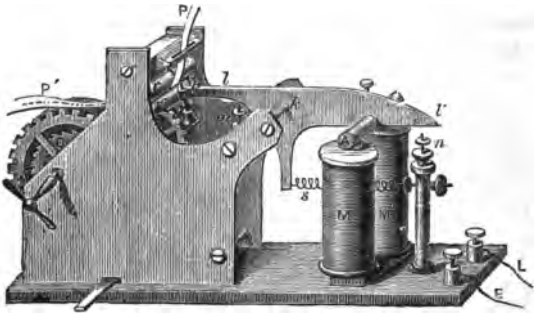


Fig. 38.

groove in the roller, *r*, and over this groove is made to pass a slip of paper, PP′, which is made to move towards P′ by the rollers, *rr′*. These rollers are worked by clock-work, independently of the rest of the machine. When the point *p* is raised into the groove on the roller *r*, a raised mark is made on the upper surface of the paper, which will be a dot or a line according to the time the point is raised, that is, according to the time the circuit is kept complete; as soon as the current ceases, the armature is left by the magnet free to rise, and the end of the lever, with the point, is pulled down by the spring *s*. By means of the dots and lines thus made on the paper, an alphabet is constructed, and words can thus be written down at the distance of thousands of miles.

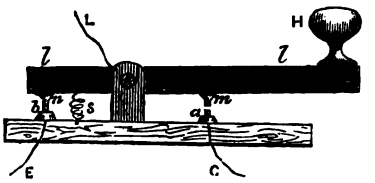


Fig. 39.

But now, how is this system of stopping and setting agoing of the current managed at the station from which the message is sent? It is done by what is called a key, fig. 39. This is a lever, *ll*, which moves on an axis, A, and is worked by

a handle, H. To the key are attached three wires: the line-wire, L; a wire, E, attached to a Morse's Recorder, at its own station; and one, C, attached to the copper plate of a galvanic battery. The ordinary position of the key is as seen in the figure, the nipple *n*, in contact with the little anvil *b*, that end of the lever being held down by the spring, *s*; so that, when a message is to be received, the current passes from L, by A, *l*, *n*, *b*, and E, to the recorder. But when a message is to be sent to another station, the handle, H, is pressed down, the contact between *n* and *b* is broken, and the nipple *m*, is now brought down on the anvil *a*. This connects the copper plate of the battery with the line-wire to the distant station; and the current passes from the copper plate through the line-wire, through the key at the distant station (which is in the position seen in fig. 39), and through the coils of the electro-magnet of the recorder. From the recorder it passes down the earth-wire, and then back, through the earth, to the zinc plate of the battery. The time during which the sharp point in the recorder is to press upon the paper, as before described, is thus regulated by means of the handle, H.

HEAT.

1. **Development of Heat.**—HEAT may be produced by mechanical means in three ways, by friction or the resistance of the surfaces of two bodies when rubbed, by percussion or the striking of one body against another, and by compression.

(1) *By Friction.*—If a smooth metal button be stuck on a cork, and rubbed on a piece of soft deal-wood, as a form, it will become heated by the friction; and if rubbed long enough, will become so hot as to scorch wood and paper, and set fire to a match. Considerable exertion of the arm, however, is required to produce the latter result. This experiment affords an illustration of a general principle in nature, that all energy expended results either in *a certain amount of work done or of heat produced.* Accordingly, energy must be so directed as to produce the exact result desired. If we wish to produce heat, as in the case of the button, or in warming one's hands, the more energy that is applied to overcome the friction, the greater is the amount of heat produced. If sufficient energy be expended, the heat becomes so great that the rubbed bodies take fire. Savages, for example, light their fires by rubbing two sticks together; forests have been set on fire by the friction of two branches waving in the wind; and destructive fires have been occasioned by friction in a piece of machinery. More generally, however, energy is directed to the performance of work, and in this case all that goes to produce heat is lost. If, when a man is

sawing wood, the blade of the saw be held by the wood, the force required to overcome this friction, although it has the effect of heating the saw, is lost, because the object is not to heat the saw, but to cut the wood. To prevent this friction, the teeth of the saw are set outward to each side alternately, so as to make an opening wide enough to allow the blade to work freely; and sometimes a piece of wood is inserted in the cut, to keep the sides apart. When the friction cannot be altogether prevented, it is eased by rubbing the saw with grease. For the same reason, the axles of wheels of carts, railway carriages, and other machines, are kept carefully greased.

(2) *By Percussion.*—On picking up a lead bullet, or rather the flattened fragment of one, just after it has struck a metal target, it is felt to be hot. The heat of the flattened ball is the exact equivalent of the force with which the bullet was moving when it struck the target, together with that communicated to the spot struck. Again, when a piece of cold iron is hammered, it becomes hot—that is, the energy expended in the blows is converted into heat in the iron, just as happens when a button is rubbed.

(3) *By Compression.*—When the density of a body is increased by compression, heat is developed according as the volume of the body becomes diminished. When books are squeezed between the plates of a hydraulic press (see fig. 19, page 17), they are found to be heated; in other words, the force applied to the press has been converted into heat. Similarly, heat is evolved when a weight is laid on a metal pillar.

From a consideration of the foregoing and many similar facts, the conclusion has been arrived at, that *heat is a form of motion.* Thus, the heat produced by a bullet striking a target is simply the motion, which the bullet had before it struck the target, transferred to the atoms of the lead as well as to those of the metal struck; and the heat of the hammered iron is simply the motion of the hammer transferred to the atoms of the iron; and similarly in any case of friction or compression.

2. **Change of Condition.**—It must be distinctly understood that *all* bodies have a greater or less amount of heat. We are obliged to conceive of a point at which there is an entire absence of heat, but of that point we have no experience, and beyond it the heat of bodies differs merely in degree. The temperature of the human body is about 90°, and we are accustomed to speak of bodies with a lower temperature than this as cold, and of all having a higher temperature as warm or hot. Taking for granted, then, that heat is motion among the atoms of the body, let us consider how different bodies are affected by it. In all bodies, the atoms vibrate backward and forward, and these vibrations have greater or less velocity and extent, according to the amount of heat in the body. The result of these vibrations is that the atoms repel each other, so as to make the body composed of them, when heated to more than its ordinary temperature, occupy a larger space. Iron, for example, expands when heated, as was

noticed under Density (page 5). There is thus a contest going on between the binding power of cohesion and the repelling power of heat. At first, with a small amount of heat, the cohesion holds its own; but as the heat increases, the vibrations become more violent, and the atoms are strongly pushed apart. Cohesion, then, has less power, because it has to act at a greater distance; therefore, as the repulsion of the heat increases, the attraction of cohesion diminishes, till the atoms gain sufficient freedom to be able to slide or roll upon one another. The body is then said to be *in a liquid state.*

In the liquid state, the power of cohesion has not been altogether conquered; the atoms, although they are movable on one another, still resist being torn asunder. But if the heat be still further increased, the last feeble efforts of cohesion are overcome, and the atoms fly apart in the form of *vapour.* When a liquid has assumed the gaseous form, it is clear that the space it occupies is very much increased; thus, water converted into steam occupies a space about 1700 times greater than it did before—that is, a cubic inch of water becomes a cubic foot of steam.

3. **Vaporisation.**—When sufficient heat has been applied to a liquid to make it assume the form of visible vapour, the first particles fly off from the surface, as is seen in the vapour that rises from all water when it becomes heated at all. Let us see what is going on meantime within the liquid mass. At the bottom of the liquid, where the heat is generally applied, the particles are being more and more repelled from one another, the liquid becomes lighter than that above it, and rises, while the liquid above it sinks down, as seen in the figure, which represents a vessel of water with a lamp under it. While this is going on, small bubbles of vapour rise from the bottom; but as they rise near the surface, where the temperature is lower, they are condensed again to water. The formation and condensation of these first bubbles give rise to the *singing* sound heard coming from water just before it boils. When, however, the whole of the water has been raised to a certain temperature, the bubbles of vapour that are formed at the bottom rise to the surface, and the water is then said *to boil.* Sometimes the bubbles are seen to rest on the surface; that is, there is a small quantity of vapour enclosed in a thin coating of the liquid. The repelling power of the heat in the steam of course tends to make it burst the bubble; but it is prevented for a short time from doing so by the pressure

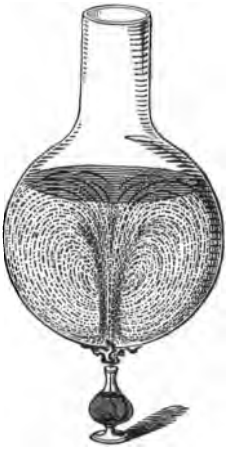


Fig. 40.

of the air, which amounts to 15 pounds on every square inch. But take a bubble when it is first formed at the bottom of the water; there the pressure on it from without is the weight of all the water above it, as well as that of the air; so that the heat necessary to raise a quantity of water to the *boiling-point* is exactly the quantity of heat that will introduce among its particles a force of repulsion sufficient to overcome the pressure arising from the weight of the liquid above it and the weight of the atmosphere. Hence, to boil a large quantity of water, its temperature must be higher than in a smaller quantity, because the pressure to be overcome by the steam in the bubbles is greater; hence too, water will boil at a much lower temperature if the pressure of the atmosphere be diminished, as is the case on high mountains.

4. **Latent Heat.**—When cold water is placed in a vessel over the fire, heat from the fire is communicated to the water, which gradually becomes hotter till it reaches the boiling-point; but, after the water boils, the temperature of the water does not rise. What, then, becomes of all the heat that continues to be communicated to it? We noticed in Section 1 the manner in which different modes of energy could be converted into heat: this is a case of the reverse process; here heat is converted into motion. For a certain amount of heat a certain amount of work is done in pulling the particles of the liquid asunder. The heat which is consumed in this way after a liquid has been raised to the boiling-point—that is, heat which goes to form vapour without raising the temperature of the liquid or of the steam—has been called *latent*, from the notion, at one time entertained, that heat was a fluid, and, consequently, that the heat which seemed to be lost in this way concealed itself in the vapour. The same thing takes place when a solid is being reduced to a liquid. When heat is applied to a piece of ice, its temperature does not rise above the point at which it began to melt till every bit of it is melted. The heat thus absorbed in the melting of ice, is called the latent heat of water; and that absorbed in converting water into steam, the latent heat of steam. When this latent heat is lost in any way, the repulsion existing among the particles diminishes, cohesion regains the mastery, and the steam returns to the form of water, or water to that of ice. It is on this principle that distillation is accomplished. The *still* usually consists of a copper boiler, in which the fermented liquor is converted into vapour; of a pipe, which conveys the vapour from the top of the boiler; and of the *worm*, a coiled metal tube packed in a vessel through which there is a constant flow of cold water. The vapour arising from the boiling liquor in the copper is deprived of its heat in passing through the tube in the cold water; in consequence of this, it assumes again the liquid form, and drops or runs in a small stream from the end of the worm into a vessel placed to receive it.

5. **Conduction** and **Radiation.**—Just as light is the vibratory motion of the particles of a luminous body, and reveals itself by affecting the nerves of the eye; so it is this vibratory motion of the particles of a hot body, when communicated to the nerves, which causes the sensation of heat. These vibrations pass in all directions, and are hence called *radiant heat.* (See OPTICS, p. 25.) Again, as sound is transmitted by solids as well as by the air, so heat is transmitted by solids. When the end of a poker is placed in the fire, a vibratory motion is imparted to the atoms of that end; but this motion is communicated from atom to atom, till the other end also becomes heated. Metals shew the greatest facility in the passing of heat in this way; in other words, they are the best *conductors* of heat. The principle on which heat is transmitted through a fluid, as described at p. 39, and represented in the figure there, is called *convection*, because the particles of the body change their position, and, as it were, *convey* the heat; in the *conduction* of metals, no particle changes its position, the motion is merely passed from one to the other.

Having hitherto treated of the heating of a body, we will now consider the process of *cooling.* The motion going on among the atoms of a heated body is communicated to the ether, and the heat is said to *radiate;* thus the hot body expends energy, the motion of its own atoms gradually diminishes, and it is said to cool. Suppose, then, it were desirable to keep it from cooling, what could be done to prevent it? If the hot body were covered with another, the heat must first be conducted through this covering before it can be radiated. Now, different bodies have different powers of conduction, so that if a hot body be covered with a bad conductor, it will be kept hot for a long time. This is the object of wearing clothes—not to warm one's body, but to keep its heat from being radiated. When a piece of red-hot metal is exposed to the air, the heat radiates from the outside, and the outer coating of cooled metal becomes a conductor to the heat in the interior. When the body cooling is a bad conductor, which is quite a different thing from the radiation of heat from the outside, the internal heat is preserved for a long time. The lava that runs as a red-hot liquid from volcanoes, and spreads out in great sheets, after cooling on the surface, so that people may walk over it, retains its heat under this crust for years, because it is a bad conductor.

6. **Evaporation** and **Dew.**—One of the most interesting phenomena connected with heat is DEW, the nature of which will be perfectly intelligible after the above explanations. When treating of the heating of liquids, we saw that, with a degree of heat much less than what would raise a liquid to the boiling-point, vapour is formed at the surface of the liquid. The formation of vapour in this way is called *evaporation.* The heat of the sun is continually causing evaporation from all bodies of

water, or from everything wet; hence it is that anything wet by and by becomes dry, and even water in an open vessel will dry up. There is always more or less of this vapour in the air, even when the sky is clearest. It is only when the vapour, from being cooled in colder air, becomes partially liquefied, that it appears as *fog*, *mist*, or *cloud*. Dew, however, is not fog or mist deposited on the ground. After the sun has set on the evening of a hot summer day, the heat of the ground radiates into the air, or the grass, say, becomes cool, while the heat from the interior is not conducted quickly enough to keep up the temperature. The vapour in the air, coming in contact with this cooled surface, is now condensed into the watery particles of dew. One of the most remarkable things about dew is, that it is not deposited, at least to the same extent, on a cloudy night as under a clear, cloudless sky. This, at first sight, seems a contradiction, but only on the supposition that the moisture falls from the clouds, not when we remember how it is really formed. For the clouds radiate back to the earth the heat which has been radiated from it; so that the surface of the earth does not become colder than the air above it, and therefore the vapour is not condensed. Heat is always transmitted from one body to another which is colder. As was seen above, a certain amount of heat or of motion communicated to ice expands it into water, and a further amount expands the water into vapour. When the surface of the earth is colder than the air containing vapour, the heat of that vapour is transmitted into the ground, and the vapour becomes water or dew; and if the ground is extremely cold, the heat in the water keeping it in the liquid state, is further transmitted into the ground, the watery particles become solid and receive the name of *hoar-frost*.

PHYSIOLOGY OF THE HUMAN BODY.

THE HUMAN BODY is a most skilfully contrived machine, composed of a great number of different parts, or *organs*,[1] all admirably adapted for the work they have to do, or, as it is technically expressed, the *functions* they have to perform. Thus, the limbs, the eyes, the ears, and the nose are organs which respectively perform the functions of motion, seeing, hearing, and smelling.

The functions performed by the organs of the body are of two kinds: (1) those that have to do with the building up and keeping in repair of the body itself; (2) those that bring the individual into connection with surrounding objects. The former have been called the functions of NUTRITION, or of ORGANIC LIFE, and include the digestion of the food, with the absorption of the nutritive materials contained in it, the circulation of the blood, and respiration; the latter are called the functions of RELATION, or of ANIMAL LIFE, and include all the forms of motion and of sensation. In the following lessons, however, we propose to describe first the bony framework, with its covering of muscles and skin; then, the apparatus for keeping the whole fit for use; and lastly, the nervous system, with the different forms of sensation which are the true links of connection between a human being and the outer world.

The Bony Skeleton.

BONE is a hard substance, composed of two kinds of material, an animal matter, called *gelatine*,[2] and a mineral or earthy matter, consisting principally of lime. To the former it owes its elasticity and toughness, and to the latter its hardness. The general appearance of bone is that of a network of minute canals, usually running lengthwise, and connected here and there by cross branches. Towards the outside, the substance of the bone is harder and more compact; and the whole is covered with

[1] From Greek *organon*, an instrument.

[2] From Latin *gelo*, to freeze, because the liquid gelatine takes the consistence of jelly when cold.

a membrane, called the *periosteum*.[1] The long, roundish bones of the legs and arms have this peculiarity, that they are hollow in the middle, and are filled with a soft, fatty substance, called *marrow*.

The skeleton is divided into the head, the trunk, and the extremities.

1. **The Head.**—The bony framework of the head, called the *skull*, is divided into two parts, the cranium and the face. THE CRANIUM[2] is the shell which contains the brain, and is composed of eight bones, of which the following six form its top and sides: *the frontal* or *coronal bone*, so called from Latin *corona*, a crown, because it forms the crown of the head, marked 1 on fig. 41; *the two parietal bones*, so called from Latin *paries*, a wall, because they form the walls or sides of the head, of which only one, marked 2, is seen in the figure; *the occipital bone*, from Latin *occiput*, the back part of the head, marked 3; *the two temporal bones*, from Latin *tempus, temporis*, the temple, marked 4. The base is formed by other two, *the sphenoid*, marked 5, *and the ethmoid*, not visible in the figure. The sphenoid, from Greek *sphēn*, a wedge, is so called because it wedges in and locks together all the bones of the head and face, being attached to fourteen distinct bones; and the ethmoid, from Greek *ēthmos*, a sieve, from its being perforated with a large number of holes, for the passage of nerves from the brain to the face, and of blood-vessels into the brain. It will be observed that the bony plates forming the upper part of the cranium are joined by ragged edges. These joinings are an elaborate system of *dove-tailing*, binding together the different pieces as firmly as if the whole were one, while certain purposes are also served by the cranium consisting of separate pieces. At the sides of the skull, some of the bones overlap each other, those above being supported by those beneath. Altogether, the bones of the skull form an arched or vaulted covering of extraordinary strength for the protection of the brain.

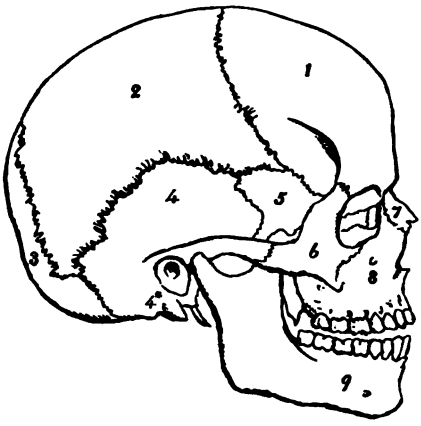


Fig. 41.

THE FACE is made up of fourteen bones, all of which, except the lower jawbone, are immovably fixed to each other, and to the bones of the

[1] From Greek *peri*, about, and *os*, a bone.
[2] Latin *cranium*, Greek *kranion*, from *kara*, the head.

cranium. By their union these bones form five cavities, which contain and protect the organs of sight, smell, and taste. The two principal bones are the upper *maxillary*[1] or *jaw* bones, marked 8 on fig. 41. Overlapping, and joined to them at the sides, are the two *malar*[2] or cheek bones, marked 6. These are joined behind to the two *palate*[3] bones, which form the back part of the roof of the mouth. The inside walls of the cavities for the eyes are partly formed by two small bones, called the *lachrymal*[4] bones, because there are holes through them for the passage of the ducts or canals which convey the *tears* from the eyes to the nose. The greater part of the nose is formed of *cartilage* or gristle, so that the bony part, formed of the two *nasal* bones, marked 7, is not very prominent. The nasal cavity is divided into two by a partition, which is partly formed by a bone called the *vomer*,[5] from its resemblance to a ploughshare; and its outer walls are formed of two small *turbinated*[6] bones, which are thin bony plates, in the form of a *scroll* or horn, the use of which will be explained when we treat of the organ of smell. Last of all, comes the *lower maxillary* or lower jawbone, marked 9.

2. **The Trunk.**—The most important part of the trunk is the SPINE[7] or backbone, so called from its spikes or points. It consists of a large number of small pieces so jointed together as to make it exceedingly flexible. Each of the pieces is called a *vertebra* [Latin, 'a joint'], and is attached to the two between which it lies by strong elastic *ligaments*;[8] while between each pair is a cushion of cartilage, which is thickest in the lower part of the spine, and serves a very important purpose. When the body is jolted in any way, for example, in jumping from a height, these cushions act like the buffers of a railway train, and neutralise the shock. From its being composed of these vertebræ, the spine is called the *vertebral column*. Each vertebra is perforated with a round hole; and from the manner in which they are joined together, these holes form a continuous canal, which contains and protects the *spinal cord*. This substance, although sometimes erroneously called the spinal *marrow*, is quite distinct from the real marrow found in the long bones of the legs and arms. It is, in fact, next to the brain, the most important part of the nervous system, in connection with which it will afterwards be described. Behind the backbone are three rows of projections; one in the centre, forming the ridge felt along the back, and seen farthest to the right in the figure, called the *spinous processes*; and one on each side of these, called the *transverse processes*. In the whole

[1] From Latin *maxilla*, diminutive of *mala*, a jaw.
[2] From Latin *mala*, a jaw.
[3] From Latin *palatum*, the roof of the mouth.
[4] From Latin *lachryma*, a tear.
[5] Latin *vomer*, a ploughshare.
[6] From Latin *turbo, turbinis*, a whirl.
[7] Latin *spina*, a thorn.
[8] From Latin *ligo*, to bind.

column there are 33 vertebræ. At the top are 7 *cervical*[1] vertebræ, or vertebræ *of the neck*. The topmost, or first cervical, is termed *atlas*, because by it the head is properly borne up, as the earth was by the fabled god Atlas. The second cervical is called the *axis*, because it is the proper axis or joint of the neck, the joint between it and the *atlas*, which is a pivot-joint, being that which enables the head to turn round. Next to the cervical are the 12 *dorsal*[2] vertebræ, or vertebræ *of the back;* after which come 5 *lumbar*[3] vertebræ, or vertebræ *of the loins*. All the above mentioned may be separated from each other, and are called *true vertebræ;* the rest, namely, the 5 that are ossified together, and form the *sacrum*, or sacred bone, and the 4, also united, that form the *coccyx*,[4] so named from its resemblance to the beak of the cuckoo, are called *false vertebræ*.

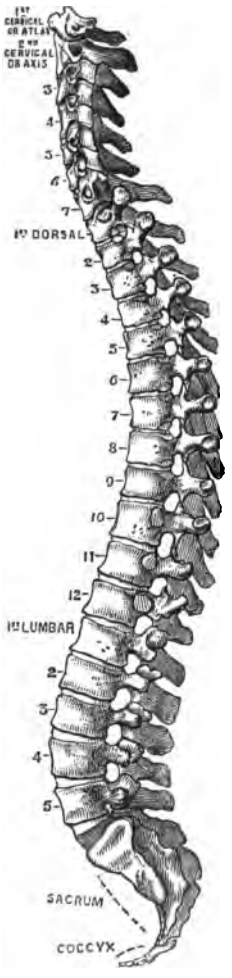


Fig. 42.

It is interesting to know that the skull is merely a prolongation of the backbone, and consists of four of the segments or vertebræ described above. The hollow space which contains the spinal cord is in these four expanded into a capacious chamber (the cranium) for containing the enlargement of the nerve-substance called the brain. The four segments of the spinal cord which correspond to the four vertebræ, and which form the basis of the brain, give off the nerves of smell, sight, taste, and hearing.

The bony part of the trunk is completed by THE RIBS, which are 24 elastic arches of bone, 12 on each side, attached behind to the dorsal vertebræ, and in front to the *sternum*,[5] or breast-bone, by a cartilaginous ligament. It will be seen from fig. 43 that the sternum does not extend far enough down to allow of all the ribs being directly attached to it; there are, in fact, only seven thus attached, which are therefore called *true* ribs. The other five are called *false* ribs. Of these, the ends of three are indirectly attached to each other and to the sternum by a

1 From Latin *cervex, cervicis*, the neck. 2 From Latin *dorsum*, the back.
3 From Latin *lumbus*, a loin. 4 Latin, 'a cuckoo.' 5 Latin, 'the breast.'

cartilaginous band; the other two are unattached to anything in front, and are therefore called *floating* ribs. The ribs, along with the sternum,

THE HEAD.

The Cranium—
1 Frontal bone.
2 Parietal bones.
1 Occipital bone.
2 Temporal bones.
1 Sphenoid bone.
1 Ethmoid bone.

The Face—
2 Upper maxillary bones.
2 Malar bones.
2 Palate bones.
2 Lachrymal bones.
2 Nasal bones.
The vomer.
2 Turbinated bones.
1 Lower maxillary bone.

THE TRUNK.

The Spine—
7 Cervical vertebræ.
12 Dorsal vertebræ.
5 Lumbar vertebræ.
The sacrum = 5 false.
The coccyx = 4 false.

The Ribs—
7 True ribs.
3 False ribs.
2 Floating ribs.

THE EXTREMITIES.

The Arm and Hand—
The humerus.
The radius.
The ulna.
8 Carpal bones.
5 Metacarpal bones.
14 Phalanges.

The Leg and Foot—
The femur.
The tibia.
The fibula.
7 Tarsal bones.
5 Metatarsal bones.
14 Phalanges.

Fig. 43.

form the bony framework of the chest, in which are placed the heart and lungs.

3. **The Extremities.**—The extremities may be divided into upper and lower, or the arms and the legs. Each member consists of a set of extended

movable bones, which are worked by means of muscles, like so many levers, and of a bony framework to which the limbs proper are attached, and which is fixed to the trunk.

(1) THE UPPER EXTREMITIES—THE ARMS.—The bone in which is the socket for the first bone of the arm is a triangular, flat bone, lying on the back of the dorsal ribs, and called the *scapula*[1] (1 in fig. 43). It lies quite freely on the ribs, and so tends to give freedom of motion to the arm; but it is very firmly supported by the *clavicle*[2] or *collar-bone* (2 in fig. 43), which is attached to a projection on the scapula. The socket in the scapula for the reception of the head of the arm-bone, is a shallow cup-like cavity, into which the round head of the bone fits; and in consequence of the shallowness of this socket, the arm has perfect freedom to move in every direction. Yet this arrangement has its disadvantage, from the greater danger there is of the head of the bone being dislodged from its place, as not unfrequently happens, security being thus slightly sacrificed for freedom of motion. It will be seen that in the case of the hip-joint, on the other hand, through the greater depth of the socket, freedom of motion is sacrificed for security and strength. THE ARM itself is divided into three parts—the arm proper (from the shoulder to the elbow), the fore-arm (between the elbow and the wrist), and the hand. The bony part of the arm proper is a single hollow bone, called the *humerus*[3] or shoulder (3 in fig. 43). The shoulder-joint has already been described; at the lower end the bone is flattish, to allow of its being jointed at the elbow to the two bones of the fore-arm—namely, the *radius*[4] and the *ulna*[5] (4 and 5 in fig. 43). The ulna is connected with the humerus by a common hinge-joint; while the radius has a pivot-joint, with a cavity in the end to receive a rounded knob on the end of the humerus, so that it is capable of a rotatory motion.

To these two bones at the wrist is attached THE HAND, which consists altogether of 27 bones. First come the 8 *carpal*[6] or wrist bones, which are arranged in two rows—3 to 10 in fig. 44, 1 and 2 being the ends of the radius and ulna. The upper surface of the first row is convex, and fits into a cup-like socket in the lower end of the radius. The first carpal bone, 3, of the first row supports, by means of 7 and 8 in the second row, the bones of the thumb and forefinger (I and II); 5 in the first row, in like manner, supports, through 10 in the second row, the bones of the little finger and of the one next to it; 4 and 9 in the first and second rows, support the bones of the middle finger. These 8 carpal

[1] Latin *scapula* = *spatula*, diminutive of *spatha*, a spade.
[2] From Latin *clavicula*, diminutive of *clavis*, a key, so called from its resemblance to a Roman key.
[3] Latin, 'the shoulder.'
[4] Latin, 'a spoke of a wheel.'
[5] Latin, 'the elbow.'
[6] From low Latin *carpus*, the wrist.

bones are very closely packed and tightly bound together with ligaments, so that the wrist is as strong as if it consisted of but a single bone; while, at the same time, the elasticity obtained by having so many bones movable on each other, neutralises, to a great extent, a shock occasioned by falling on the hands. Next to the carpal bones come the 5 *metacarpal*[1] (11—11), which form the comparatively long bones of the back of the hand. Last of all, come the 14 *phalanges*[2] or bones of the fingers (12—14), a name also applied to the corresponding bones of the foot.

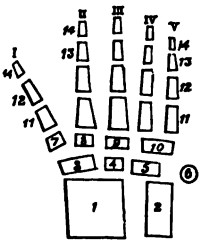


Fig. 44.

(2) THE LOWER EXTREMITIES—THE LEGS.—The plan of the bony framework of the legs is very similar to that of the arms. The principal point of difference is, that the structure of the former is stronger, in order to support the weight of the body; strength and solidity being in the lower limbs of even more importance than freedom of action, which we saw to be so well provided for in the arms. The whole framework to which the lower extremities are attached, and which also forms a *basin*-like cavity for supporting the contents of the abdomen, is called the *pelvis*[3] (6 in fig. 43). In a full-grown person, the pelvis consists of a single bone, called the *os innominatum* or 'nameless bone.' On the under side of the spreading part of the pelvis is a cup-like socket, to receive the rounded head of the thigh-bone. The deepness of the socket here, while it does not allow so much freedom of action to the leg, makes the joint a very secure one (compare what is said on the shoulder-joint, page 48). In the thigh there is only one bone, the *femur*[4] (7 in fig. 43), which is jointed at the knee to the two bones of the leg proper. These are the *tibia*,[5] or shin-bone (8 in fig. 43), the larger of the two, and the *fibula*[6] (9 in fig. 43). It is the tibia alone which supports the thigh-bone, so that the fibula, as its name indicates, forms merely a sort of connection between the knee-joint and the ankle, and serves for the attachment of muscles. On the knee-joint, which is a pure hinge-joint, is a small separate bone, the *patella*,[7] or knee-pan (10 in fig. 43), the object of which is to change the direction of the tendons of the muscles that come down from the front of the thigh to be inserted in the tibia, so as to enable them to act more advantageously, according to the principle afterwards explained (see p. 52).

THE FOOT consists of 26 bones, which are arranged on a plan very similar to, if not identical with, that of the hand. In the hand, we had

[1] From Greek *meta*, after, or coming after.
[2] From Greek *phalangx*, the lines of an army drawn up in battle array.
[3] Latin, 'a basin.' [4] Latin, 'the thigh.' [5] Latin, the 'shin-bone.'
[6] Latin, 'that which fastens two things together.'
[7] Latin, diminutive of *patina*, a pan or dish.

carpal and metacarpal bones; in the foot, we have *tarsal* and *metatarsal;* and in both there are *phalanges.* The *tarsal*[1] bones, seven in number, compose the heel and the hinder part of the instep. Fig. 45 exhibits the beautiful arch which is formed by the bones of the foot, called the *plantar* arch from Latin *planta,* the sole of the foot. On the top of the arch is the large bone, D, which supports the tibia of the leg, the end of which is seen in the figure. The bone, D, is supported principally by the heel-bone F, the largest bone of the foot, but also, in front, by the bone E, and the ligament B, which binds E to F. D, E, and F correspond to bones 3, 4, and 5 in the hand; while in front, and at the outer side of E, are four bones corresponding to 7, 8, 9, and 10 in the hand. In the front part of the instep are the five *metatarsal* bones corresponding to 11—11 in the hand. To the metatarsal bones are jointed the *phalanges,* or bones of the toes, each toe having three, except the great toe; just as in the hand each of the fingers had three phalanges, but the thumb only two.

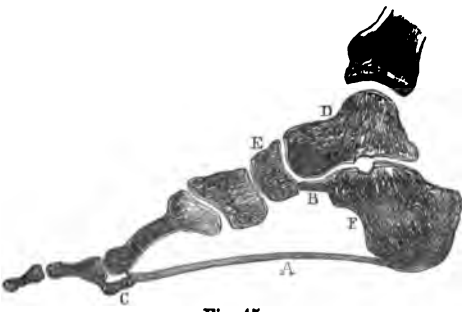


Fig. 45.

Such is an outline of the bones composing the framework of the body. The coatings of flesh or muscle which cover this skeleton, and the skin, the outer covering of the whole, are now to be described.

The Muscles.

Muscular Tissue is the soft, fleshy covering of the bones, by means of which all the movements of the body are made. This faculty which it possesses of causing motion is due to its contractility. A mass of this tissue attached to certain bones, is called a *muscle.* When a muscle is closely examined, it is seen to consist of a great number of fibres regularly arranged lengthwise. It is further seen that these fibres are connected together in bundles, of different sizes, enclosed

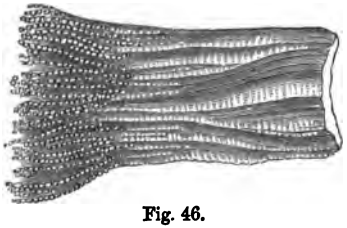


Fig. 46.

[1] From low Latin *tarsus,* Greek *tarsos,* the instep.

in sheaths of another kind of tissue. Fig. 46 represents such a bundle of fibres. The individual fibres, again, are streaked in two ways—lengthwise and crosswise. When separated from each other, they often split up into *fibrillæ*,[1] or little fibres, as seen in fig. 47. Other fibres, when extended, separate, according to the cross streaks, into discs, as seen in fig. 47, *a*, *b*; and when this separation takes place both ways at once, the fibre is separated into a mass of particles, *b'* in fig. 47. When a muscle is being contracted, these cross discs of the individual fibres become more closely squeezed together, and the fibre becomes thicker as it is shortened, in a manner similar to what is seen to take place in the body of a worm, when it is drawing itself up after having put forward its head.

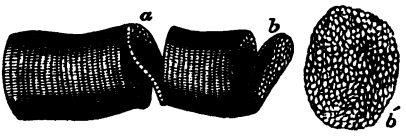


Fig. 47.

The muscles are attached to the bones by means of *tendons*,[2] which are white, smooth, non-elastic bands at the ends of the muscles, of a different structure from the muscle itself. Of the two component parts of fibrous tissue, the elastic and the non-elastic, only the non-elastic, which is white, is found in tendons; a tendon being formed of fibres of this white tissue, one fibre coming from each fibre of the muscle. The tendon itself is a tough, white mass, attached to the bones by the individual fibres becoming fixed in depressions in the bones, and also by becoming amalgamated with the hard outer part of the bone called the *periosteum*. The muscle being thus attached at its ends to two bones, a distinction is made between the two ends; the point of attachment to the less movable bone is called the *origin*, while that to the bone specially to be moved is called the *insertion*; thus, the muscle which bends the elbow is attached to the shoulder and to the fore-arm; the point of attachment of this muscle at the shoulder is its origin, and the point of attachment in the fore-arm its insertion. Muscles such as the one here alluded to—that is, those that bend joints, the best example being the muscles that bend the fingers on the palm—have a particular name, *flexors*, or benders, from Latin *flecto*, to bend. Where such muscles exist, there is always, of course, another set that reverse this bending action, or extend the bones connected with the joint, and are hence called *extensors*, from Latin *extendo*, to extend; such are the muscles that open the hand, by extending the fingers. Muscles which act in opposition to each other in this way, as flexors and extensors, are said to be *antagonistic*, or the one is said to be the *antagonist* of the other.

The various bones acted on by the muscles are like so many levers

[1] Latin, diminutive of *fibræ*, threads.

[2] From Latin *tendo*, to stretch.

(PHYSICS, p. 11); the fulcrum is generally a joint; the power is a muscle, the force being exerted by contraction, and the weight the farther end of the bone or limb. They are all levers of the third kind (PHYSICS, p. 9), the power acting between the weight and the fulcrum, and therefore acting at a mechanical disadvantage—that is, a power greater than the resistance has to be exerted in order to accomplish the movement. There is another disadvantage which the muscles labour under in working, arising from their being attached to the bones in an oblique direction; but this is partly done away with by means of the peculiar formation of the bones—that is, by a thickening at the joints. Thus, in fig. 48, A, when a bone (*o*) is to be moved, the tendon (*i*) of the muscle (*m*) comes over the thickened part of the bone at the joint, and is attached immediately below it, so that the attachment of the muscle is more nearly perpendicular than it would otherwise have been. By this means the bones turn more freely on each other; otherwise the ends of two bones would merely be pressed together, as in fig. 48, B. As regards the mechanical disadvantage from the nature of the lever, it is compensated for, we know, by the gain in velocity (PHYSICS, p. 10), as will be seen from the consideration of one case, the raising of the fore-arm. The lever to be raised is the fore-arm, *bc*, the weight being whatever is in the hand; the fulcrum is at the elbow-joint; the power is in the muscle *d*, inserted at *e*. Now, it is clear that when the muscle is contracted a little, the hand will be raised a distance proportioned to the length of the arm, and, of course, must move proportionally quicker; while, at the same time, the power exerted by the hand requires an exertion on the part of the muscle greater exactly in the same proportion (PHYSICS, page 11). This is the general principle on which the muscles of the body act.

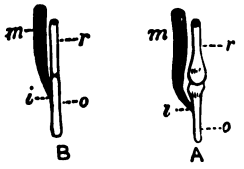


Fig. 48.

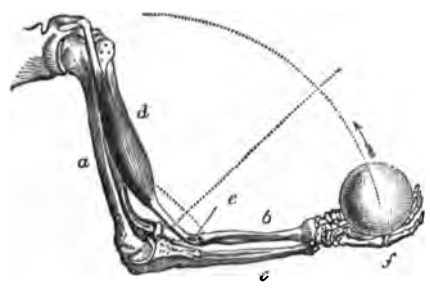


Fig. 49.

Principal Muscles of the Body.—Space will not permit a detailed description of the various muscles of the body: a few of the principal muscles only can be mentioned. The various emotions of pleasure, anger, wonder, scorn, &c., are expressed in the face by a smile, a frown, a raising of the eyebrows, a curl of the lip, &c., which are caused by the action of the

muscles round the eyes and the mouth, of those in the cheeks, and of those that raise and depress the eyebrows and the nose, &c. The most important muscles of the skull are those attached to the lower jaw, by which the food is chewed. The largest of these, called the *temporal* muscle, is attached to the flat surface of the temporal and parietal bones, and is assisted by another, called the *masseter*, a Greek word meaning 'the chewer.' The head is kept balanced on the neck by means of strong muscles, the constant exertion of which is necessary to keep it erect. The body is kept erect on the legs by a set of muscles attached to the thighs and to the bones of the pelvis, which do the double duty of moving the legs and of supporting the trunk, as well as of raising it to an erect posture on being bent down.

The arm is raised from the side by a large muscle on the shoulder, called the *deltoid* from its resemblance to the Greek letter *delta*, Δ. From under it arise two muscles which respectively bend and extend the fore-arm. That which bends the fore-arm is called the *biceps*[1] or two-headed muscle, and that which extends it the *triceps*[2] or three-headed muscle. The biceps forms a great part of the fleshy mass in front of the arm, and the triceps forms the fleshy mass at the back. The turning movements of the hand are effected principally by the radius. The turning of the palm of the hand *downward* is called *pronation*,[3] while turning it *upward* is called *supination*;[4] and the muscles by which these movements are performed are called respectively *pronators* and *supinators*. The wrist and hand are bent upon the fore-arm by three muscles, which have their origin from the inner end of the humerus, and one of which spreads out into a fan-like membrane on the palm of the hand. Under this palmar membrane lie the flexor muscles of the fingers. The antagonists of these flexors are the common extensors of the fingers, a special extensor of the fore-finger, the muscles of the thumb, accumulated in the *ball* of the thumb, which move it in every direction, and several other muscles of less importance.

The thigh is raised and advanced by means of two muscles, which descend in front of the pelvis—one from the lumbar vertebræ, and one from the upper expanded surface of the pelvis. The antagonists of these, the muscles which draw back the thigh, have their origin on the back and under surface of the pelvis.

The muscles which bend the knee proceed from the lower border of the pelvis and the back of the thigh-bone, and are inserted in the sides of the tibia and fibula, a little below the knee. The tendons of these are felt behind the knee, and are known as the *hamstrings*. The extensors of the

[1] From Latin *bis*, twice, and *caput*, a head.
[2] Latin *tres*, three, and *caput*, a head.
[3] From Latin *pronus*, with the face downward.
[4] From Latin *supinus*, with the face upward.

knee, the muscles that straighten the knee-joint, proceed from the front of the pelvis and from the femur itself, forming the fleshy mass in front of the thigh.

The most important muscle of the foot is that which forms the calf of the leg (A, fig. 50). It is of immense strength, because in raising the heel it has to raise the weight of the whole body. It is attached above to the bones of the thigh and leg, and is inserted by the tendon of Achilles, as it is called (*a*), to the heel-bone. Another muscle, B, is attached to the tibia, and inserted in one of the bones of the arch of the foot; and a third is attached to the fibula, and inserted in the outer metatarsal bone. These two last being inserted into the outer and the inner edges of the instep, turn round the outer and inner ankle respectively. The raising of the toes, the turning of the foot outward, and the straightening of the sole, are effected by other two muscles (F, fig. 50, and a similar one on the other side), the tendons of which pass down in front of the inner and outer sides of the ankle, and are inserted in the inner and outer edges of the instep respectively.

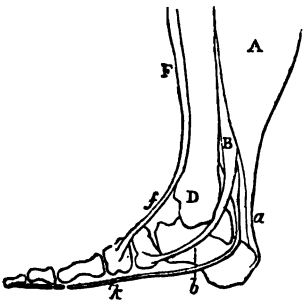


Fig. 50.

The Skin, Hair, &c.

THE SKIN consists of two layers, the true skin and the scarf-skin; the former being called the *dermis*[1] or *cutis*,[2] and the latter the *epidermis*[3] or *cuticle*.[4] The dermis forms the thick layer of the skin, and is a strong, supple, elastic membrane, formed of a compact kind of tissue, which, in its ordinary form, has a spongy appearance, being full of little cells. This tissue is composed of two elements—a yellow or elastic substance, and a white or inelastic, tough substance; and these substances are arranged in various proportions, according to the nature of the covering that is wanted at a particular place. The cutis also varies as to thickness, according to the amount of resistance or of protection required for the part covered; thus, on the sole of the foot, the cutis is very thick, and is composed principally of the tough white substance. On the outer surface of the cutis are a number of small flexible elevations, called *papillæ*[5] or pimples, which will be mentioned again in treating of the

[1] From Greek *derma*, skin.
[2] Latin, 'skin.'
[3] From Greek *epi*, upon, *derma*, skin.
[4] From Latin *cuticula*, diminutive of *cutis*, skin.
[5] Latin, diminutive of *papulæ*, pimples.

senses of touch and smell. Imbedded in the cutis are the sweat-glands,[1] which separate from the blood the fluid which appears on the skin when one is heated. These glands send forth their fluid by *ducts*[2] or canals of a spiral form. Besides these glands, there are, in the cutis, two kinds of *follicles*[3] or 'little bags' connected with the hair. These are the *hair follicles* proper, which are little pits in the cutis, in which the roots of the hair are developed; and the *sebaceous*[4] follicles, which are glands for the secretion of *a fatty matter* supplied to the hair when it comes above the skin, to prevent its being too much dried up. Each hair consists of a 'bulb' and a 'shaft;' and the shaft, again, consists of a soft, pith-like part in the middle, with an outer and harder layer. The bulb consists of a mass of the cells of which the cutis is composed, developed at the bottom of the follicle. The inside of the shaft contains something of the same kind; while its outer layer is simply these cells dried and turned into a scaly nature. This is, in fact, exactly the composition of the *epidermis;* the cells which are on the surface are dried and flattened into scales (as seen in the scurf thrown off the skin of the head, especially under the hair), so as to form a transparent, insensible varnish for the sensitive cutis. So, too, the *nails* are formed; the horny substance of which they consist being composed of these dried and hardened cells, which are being continually pushed outward by a development of fresh cells at the root of, and under, the nail.

Nutrition.

Having described the framework of the body, we now proceed to consider the manner in which it is kept in repair. When anything is said to be kept in repair, it is understood that it is already made or formed; and so here it is understood to be a full-grown human body that is to be nourished. And this process is different from either 'growth' or 'development.' Development is the process by which each part of the body is first formed or so changed as to be adapted to perform a higher function. Growth, again, is the mere increase, principally in size and weight, without any change in form, of the different parts by the addition of matter similar to that composing them. During the whole period of life, there is continually going on in all parts of the body a process of decay, and the casting off of substances which have become useless and even positively injurious in the economy of the body. Nutrition, then, includes the different processes of Digestion, Absorption, Secretion and Excretion, Circulation of the Blood, and Respiration, by

[1] A *gland* is an organ, having blood-vessels, absorbents, and nerves, for secreting a certain fluid from the blood.

[2] From Latin *duco*, to lead.

[3] Latin *folliculus*, diminutive of *follis*, a bag.

[4] From Latin *sebum*, fat.

which the decaying matter of the body is carried away and fresh material supplied in its place.

The process of Digestion may be divided into the following parts—1. The Mastication of the food; 2. The Insalivation; 3. The Deglutition or swallowing; 4. The Chymification or digestion in the stomach; 5. The Chylification or digestion in the intestines; and 6. The Absorption of the chyle.

1. *Mastication* or chewing is performed by the teeth. These are small, hard, white bodies, fixed in the jaws, so as to come against each other, and reduce the food by cutting and bruising it. They are formed of three substances—dentine, cement, and enamel. The inside and body of the tooth are formed of *dentine*, so called from Latin *dens*, *dentis*, a tooth; outside of this is a layer of cement, which is softer than dentine; but where the tooth appears above the jaw, the cement is replaced by a hard *enamel*, which forms a very strong protection for the exposed part of the tooth, called the *corona* [Latin, 'a crown']. There are in all 32 teeth in man, and these are of three kinds: the *incisive*[1] or cutting teeth, in front; the *canine*[2] or dog-teeth, next to the cutting-teeth on each side; and the *molars*[3] or grinders, behind, ordinarily called *double* teeth, because they have a double edge, instead of a single one like the front teeth. The *incisors* have a single fang or root, and the *corona* is bevelled behind, so as to present a sharp, chisel-like cutting edge. There are two on each side of both jaws, that is, eight altogether, and they are used for biting the food, *aa*, fig. 51. The *canine* teeth, so called because they are very prominent in dogs, have a single root, and their corona is more pointed than edged, *bb*, fig. 51. The *molars* are divided into *true* and *false*. First come (in a half-jaw, as A, fig. 51) two *false molars* or *premolars*,[4] so called because they are placed *before* the *true* molars, *c*, which are of a form between that of the canine teeth and the true molars. Last of all come the true molars, *d*, which are larger than any of the other teeth, and have a corona well adapted for bruising the food.

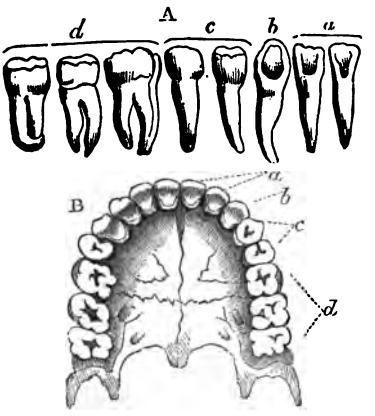


Fig. 51.

1 From Latin *incido*, *incisum*, to cut.
2 From Latin *canis*, a dog.
3 From Latin *molo*, to grind.
4 From Latin *pre*, before.

The different kinds of teeth with which man is furnished indicate that his food is intended to be of a mixed nature. Those animals that live entirely on flesh have back teeth with sharp, jagged edges, which fit into each other, and act very much like scissors, tearing and cutting their food; partly of this nature are the incisive, canine, and premolar teeth of man. Those animals, again, that live entirely on vegetable food, have broad-headed teeth, very uneven and rough on the top, the joint of the jaw having a freer motion, so that the jaws rub on each other sidewise, and thoroughly bruise the food, as if with millstones. This kind of teeth is found in the molars of man; and the under jaw has this side-motion, to a certain extent.

2. *Insalivation.*—While the food is being chewed, it is mixed with *saliva* or spittle. This is a colourless, tasteless fluid, which is secreted by three pairs of glands, one pair in front of the ears, a second under the jaw, one on each side, and a third under the tongue, one on each side. The saliva, by moistening the food, renders it more easily swallowed; the moisture also helps in the separation of the particles of the food, and in the sense of taste. Another purpose served by the saliva is the conversion of the starchy matter of the food into sugar, which promotes its absorption.

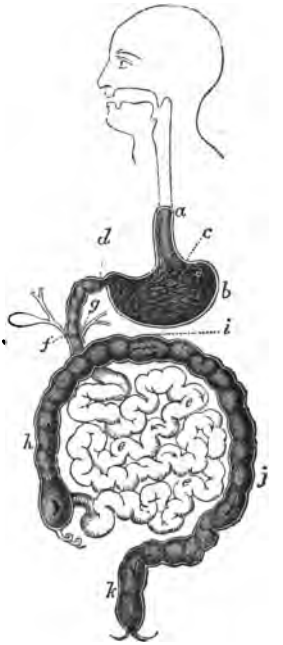


Fig. 52.

3. *Deglutition.*—The *pharynx*[1] or entrance to the gullet, is closed, while the food is being chewed, by the soft palate, which is a fleshy valve hanging down from the roof of the mouth. As soon, however, as the food is properly chewed and mixed with saliva, it is pushed backward by the tongue, and the soft palate is immediately drawn backward and upward, and the food enters the pharynx. As soon as this happens, it is beyond recall, except by the involuntary action of coughing, for it is carried into the stomach by the action of the muscles of the gullet, which are excited by the presence of the food. The principal muscles of the gullet are circular, or surround it like a number of elastic rings; so that, when a mouthful of food has been pushed into the pharynx by the

[1] Greek, 'a cleft.'

tongue, it is moved onward through the gullet by the continual contraction of the elastic rings behind it. In this manner, the food finds its way into the stomach. The course taken by the food will be best understood from an outline sketch of the Alimentary Canal (fig. 52), which is the whole digestive apparatus through which the food passes. The gullet (*a*), in its passage to the stomach, passes through an opening in the *diaphragm*,[1] a large, flat muscle, which forms the partition between the chest and the abdomen. Immediately below this, it enters the stomach, a large, muscular bag (*b*), widest at the end where the gullet enters (*c*); from the narrower end proceeds the smaller intestine, which is generally about twenty feet long, and, rolled up in numerous folds (*e*, *e*), occupies the middle of the abdomen. The small intestine is attached to the large intestine (*h*, *i*, *j*, *k*), which is about five or six feet long, and passes upward on the right side of the folds of the small intestine (the right side of the figure is the left side of the man), across to the left, and then down to the *anus* or lower orifice of the alimentary canal, by which its contents are discharged.

4. *Chymification.*—When the food enters the stomach, the process of *digestion* immediately begins. This consists in the reduction of the food to a thoroughly broken-up, thin, pulpy mass, so as to allow of the nutritive part being received into the system. For this object, it is mixed with a fluid, called the *gastric*[2] juice, which is secreted in a great many little bags in the walls of the stomach, and poured out whenever food enters the stomach. To facilitate this mixture, there is a provision made for stirring it about. The walls of the stomach are composed partly of strong muscles; and when the food enters, which it does at the upper left-hand corner (*c*, fig. 53), by the contraction of these muscles, it is pushed towards the right, along the top (*a*, *a*). When it comes to the right extremity, it is pushed back to the left, but now nearly in the middle (*b*); and when it comes back to the left, the opening being firmly closed by muscles, it is divided into two streams —one going along the top, and the other along the bottom. By this means, the food is thoroughly mixed with the gastric juice, and reduced to a half-fluid pulp, called *chyme* [Greek *chymos*, juice]. The gastric juice consists of two elements—an acid, and an organic matter called *pepsine*, from Greek *peptō*, to digest; and the uses of it are to dissolve and modify all animal

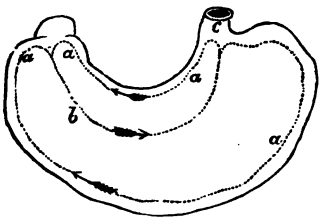


Fig. 53.

[1] From Greek *diaphrassō*, to divide by a partition. [2] From Greek *gastēr*, the stomach.

food, except fat, and all the blood-forming portion of vegetable food.

5. *Chylification.*—When a certain quantity of chyme has been formed in the stomach, the valve which closes the *pyloric*[1] orifice (*d*, fig. 52), or opening between the stomach and the small intestine, is opened, and it passes out; but no food is allowed to pass out that has not been properly mixed with and acted upon by the gastric juice. In the small intestine, the chyme is mixed with three new fluids—the *bile*,[2] the *pancreatic*[3] juice, and the *intestinal* juice. The bile is a greenish-yellow liquid, secreted by the liver, and kept stored in a little bag near it, called the gall-bladder, from which, as well as directly from the liver, it is discharged into the intestine, close to where the latter leaves the stomach, *f*, fig. 52. Its principal function is to digest the fatty part of the food, which the gastric juice does not act upon. The pancreatic juice is a fluid very like saliva, which is also poured into the intestine at the same place as the bile, *g*, fig. 52. One of its functions is to complete what was begun by the saliva—namely, to convert starchy matter into sugar. It also serves further to dilute the chyme, and performs a very important chemical process, too complex to be described here. The intestinal juice unites in itself the properties both of the saliva and of the gastric juice—namely, the power of converting starchy matter into sugar, and of dissolving all animal food but fat, and the blood-giving portion of vegetable food.

In the intestine, then, we have seen that there is a provision for reducing nutritious matter of every kind to a state fit for absorption, the fluid here acting on the food being compounded of the saliva, the gastric, the pancreatic, the intestinal juices, and the bile. And as the process of thus reducing the food is being carried on whilst the food moves through the intestine, so the nutritious part is being withdrawn by absorption. One part, which is perfectly reduced, and fit for passing into the system at once, is taken up by the blood-vessels (in the stomach as well as in the intestine); another part, which seems to be blood 'in an early stage of its formation, with a large excess of fatty matter,' is called *chyle* [Greek *chylos*, juice], and is taken up by the *lacteals*,[4] a system of absorbent vessels, so called from the white, milk-like appearance of their contents.

After the chyle has been taken up by the lacteals, there remain certain parts of the food which have been rejected as comparatively worthless for nutrition. This portion of the food, called the *fæces* [Latin, 'grounds'], passes from the smaller into the larger intestine, in which most of the

[1] From Greek *pylouros*, a porter, from *pylē*, a gate, and *ouros*, a guardian.

[2] Latin *bilis*, connected with *fel*, *fellis*, the gall-bladder.

[3] From Latin *pancreas*, a fleshy gland under and behind the stomach, by which the fluid is secreted, from Greek *pan*, all, and *kreas*, flesh.

[4] From Latin *lac*, *lactis*, milk.

remaining fluid is absorbed. This intestine, though not so long as the small intestine, is wider than it, because a greater capacity is required, on account of accumulation.

6. *Absorption.*—Both in the stomach and in the smaller intestine, part of the nutritive materials of the food is received directly into the system by the blood-vessels; but besides this, there is another system of absorption going on, on a more roundabout plan, by means of the *lymphatics*,[1] which are absorbent vessels that originate in all parts of the body. From the body in general, they collect the fluid which has escaped from the blood-vessels into the different tissues, as well as the particles of worn-out tissues, and convey both into the venous circulation near the heart. At their extremities, the lymphatics are spread out in a minute network, from which they pass to the lymphatic glands, or to a larger trunk. In passing through these glands, which are small solid bodies found in the course of the lymphatic vessels—for example, in the neck, the armpit, the groin, &c.—the fluid receives a part of its peculiar properties.

The *lacteals*, already mentioned, are simply the lymphatics of the smaller intestine; but the fluid they carry is called chyle instead of lymph. On the inner coat of the small intestine are a great number of small conical projections, called *villi*, from Latin *vellus*, a fleece of wool. At the points of these villi, the lacteals take their origin. They then pass between the two folds of the membrane which connects the intestine with the cerebral column, and make their way to a pouch or bag in the lumbar region, from which the *thoracic*[2] duct conveys the chyle upward along the spinal column to above the level of the heart; then crossing to the left side, it joins another vein by which its contents reach the heart.

Circulation of the Blood.

The process of digestion just described prepares a fluid called the BLOOD, which conveys nutriment to all parts of the body. It at the same time takes up all waste matter, which is carried to the lungs, where it is discharged, and a supply of new matter received from the air, as will be explained under RESPIRATION.

To effect all this, a continual circulation of the blood is necessary, which is produced by a very simple but effective pumping apparatus called the Heart.

The blood itself consists of a nearly colourless fluid called the *liquor of the blood*, and, floating in this fluid, an immense number of round, flat particles called *globules*,[3] or *corpuscles*.[4]

1 From Latin *lympha*, water.
2 From Latin *thorax*, the chest.
3 From Latin *globulus*, diminutive of *globus*, a ball.
4 From Latin *corpusculum*, diminutive of *corpus*, a body.

The *liquor of the blood* consists of water in which are dissolved a quantity of a substance called *fibrine*,[1] a good deal of albumen, to which all the tissue-forming elements of the food are reduced, a quantity of fatty matter, and other organic substances, with a quantity of mineral matter, principally salt. The fibrine is the substance which coagulates in the blood (it may be seen by beating fresh blood with a stick, to which it adheres in fine threads—hence its name); and it is this property that forms the beautiful provision for the repair of injuries. Were it not for this power of coagulating, a great quantity of blood might be lost by the smallest cut or scratch. The purpose of the albumen, along with the fatty matter also in solution in the blood, is to be expended in keeping up the solid tissues of the body, by which it is being continually appropriated. The liquid in which the fibrine and albumen are dissolved has the power of absorbing gases, so that the 'liquor of the blood,' besides continually building up the tissues of the body, also conveys to them oxygen from the lungs, and carries back the carbonic acid which is set free in the tissues. But in this duty, the heaviest part of the work is performed by the properly solid part of the blood, the red corpuscles; and these, again, besides this function, are principally concerned in the production and renewal of the muscular tissue.

The apparatus by which the blood is conveyed to every part of the body, to perform the functions just described, consists of two systems of tubes to convey the blood, called blood-vessels, and the heart, which is in reality a force-pump of great power. The two sets of blood-vessels are the *arteries*, which carry the blood from the heart throughout the body, and the *veins*, which bring it back to the heart. There is, besides this, a second circulation. When the blood returns to the heart, it is unfit to be again sent out until it be purified by exposure to the air: this is accomplished in the lungs, so that all the blood thus returned to the heart is immediately sent off to the lungs, from which it comes back to the heart; and this is called the *Pulmonary*[2] or *Lesser Circulation*. There are thus two sets of arteries and two sets of veins, the vessels which carry the blood from the heart to the lungs, and *vice versâ*, being called pulmonary arteries and veins respectively; although it is to be remembered that the kind of blood contained in the arteries and veins of the different sets is reversed, the pulmonary arteries containing true venous blood, and the pulmonary veins carrying back to the heart true arterial blood.

The HEART is a strong muscular bag, situated in the left side of the chest. It contains four chambers or divisions, the two in the upper end called *auricles*[3] (*d* the right auricle, and *k* the left, fig. 54), and the two in

[1] From Latin *fibra*, a thread.
[2] From Latin *pulmones*, the lungs.
[3] Latin *auricula*, diminutive of *auris*, the ear.

the lower end, *ventricles*[1] (*a* the right, and *m* the left, fig. 54). And as the most important division of the heart is into two sides, there are a right and left auricle and a right and left ventricle. Between each auricle and the ventricle on the same side, there is a valve (*c* and *l*, in fig. 54), like those in a force-pump [PHYSICS, page 17], through which the blood is forced, by the muscular contraction of the heart, from the auricle into the ventricle. The blood brought back from the body is poured, by the two veins *f* and *b*, into the right auricle; the right auricle contracting on this blood, drives it through the valve, *c*, into the right ventricle; the right ventricle now contracting, drives the blood, which cannot pass back to the auricle, because the pressure on it closes the valve, along the pulmonary artery, branches of which, *g* and *i*, go to the right and left lung respectively. The blood is brought back from the lungs by the pulmonary veins, two from each lung, *e*, *e'*, and poured into the left auricle; the contraction of the left auricle drives the blood through the valve, *l*, into the left ventricle; the left ventricle contracts, and drives the blood into the large artery, *h*, called the *aorta*,[2] because it seems to suspend the heart between the lungs.

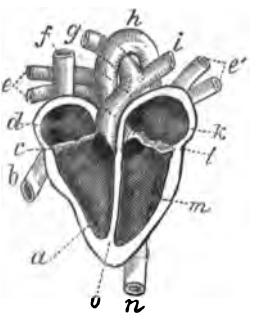


Fig. 54.

The whole of the arterial blood leaves the heart by the one large trunk of the aorta; this trunk soon divides into branches; these branches subdivide into smaller branches, and these into smaller still, until every part of the body, especially at the surface, is intersected with such a network of small arteries, that the point of a needle cannot be inserted into the flesh without wounding one or more of them, and thus drawing blood. To a certain extent, the *veins* might be said to run parallel with the arteries, branch for branch, with this difference, that they are carrying back to the heart the blood which has oozed into them through the *capillaries* from the arteries. It will easily be understood that the force of the blood in the arteries, as propelled direct from the heart, must be much greater than in the veins, in which the blood is found after it has passed through a succession of most minute tubes, where much of its velocity is lost. Accordingly, the arteries are of a much stronger structure than the veins. In consequence of the strong flow of blood through the larger arteries, they are, for the most part, placed at a distance from the surface, so as to be protected from injury; the veins, on the other hand,

[1] Latin *ventriculus*, diminutive of *venter*, the belly. [2] Greek *aortē*, from *aeirō*, to suspend.

lie, for the most part, near the surface, which renders them more liable to injury; but the consequences are less serious than in the case of the arteries, on account of the less rapid flow of blood.

The minute vessels which form the connection between the smallest branches of the arteries and the veins are called the *capillaries*,[1] from their extreme smallness. The figure (55) shews the arrangement by which the arteries and veins are connected in muscular tissue.

Fig. 55.

When the aorta leaves the left ventricle, it rises towards the neck, but soon turns downward, forming a curve called the *arch*; this trunk passes down in front of the spine, and divides into two main branches, which proceed to the legs. From the *arch* of the aorta are given off the arteries that supply the head and arms with blood: these are the two *carotid*[2] arteries (*c* and *e*, fig. 56), which ascend on either side of the neck to the head, and the two *sub-clavian* arteries, which pass beneath the clavicles to the arms (the left of these is marked *g* on fig. 56). The descending aorta while passing down gives off branch arteries to the different parts and organs—the *cœliac*[3] artery, which subdivides into three, to supply the stomach, liver, and spleen, one to each kidney, and two to the intestines. It at last divides into two branches, which supply the legs.

The veins of the body unite to form two large trunks, the *superior* or descending, and *inferior* or ascending *vena cava*,[4] which meet as they enter the right auricle of the heart, *f* and *b*, fig. 54. The descending *vena cava* is formed by the union of the veins bringing the blood back from the head, the *jugular*[5] veins, *b* and *f*, fig. 56, and those bringing it from the arms, the *sub-clavian* veins, *a* and *h*. The ascending one brings it back from the legs, the organs in the abdomen, and the trunk. The Lesser Circulation will be described under Respiration.

[1] From Latin *capilla*, a hair.

[2] From Greek *karoō*, to stupefy, because a state of torpor is brought on by stopping these arteries.

[3] From Latin *cœlia*, the belly.

[4] Latin, 'hollow vein.'

[5] From Latin *jugulum*, the hollow at the neck above the collar-bone.

Respiration.

The function of Respiration is performed in the lungs with common air. Air is composed of about 1 part of a gas called *oxygen*,[1] and 4 parts of another, *nitrogen*,[2] with an exceedingly small quantity of a third, *carbonic acid*. The change effected on air by respiration is the giving off one of these gases, oxygen, and receiving another, carbonic acid, in its place.

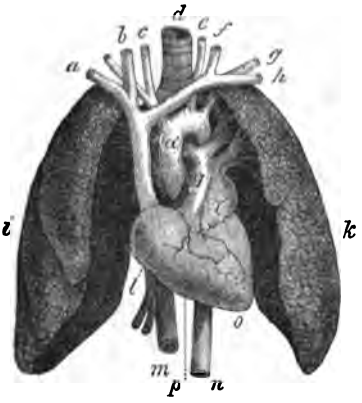


Fig. 56.

The chief difference between arterial and venous blood is, that the former contains oxygen, while the latter contains carbonic acid; and also that when the venous blood is sent from the heart to the lungs, its errand is simply to discharge this carbonic acid, and receive in exchange a supply of oxygen, with which it returns to the heart, ready to be sent off again throughout the body. It is clear then that in the lungs there must be (1) a provision for the blood coming in contact with the air; (2) an arrangement by which the blood in contact with the air shall be continually changing; and (3) an arrangement by which the air in contact with the blood shall be continually changing.

Let us consider, first, the provision for bringing the blood into contact with the air. It consists generally in having an immense extent of internal surface, covered by a complete network of minute vessels, through which the blood to be acted upon flows, separated from the air which has been inhaled only by an extremely thin membrane, so that the effect is the same as if the two were in actual contact. But how is this immense extent of surface obtained in a small compass; for the lungs are of moderate size? It is accomplished by the peculiar structure of the lungs. When the main air-tube or windpipe descends to the level of the lungs, it divides into two branches, called the *bronchi* [plural of Latin *bronchus*, the windpipe], one going to each lung (B, fig. 57). These again divide and subdivide into smaller tubes, called *bronchial* tubes, as *b*, *b*. They subdivide in this way, until at length an immense number of minute tubes is formed,

[1] From Greek *oxys*, acid, and *gennaō*, to produce.
[2] From Greek *nitron*, soda, and *gennaō*, to produce.

each of which opens into a small sac, a little wider than itself. Each of these, again, is partitioned off into a number of cells. Into the smallest of these cells the air has access, and it is on their walls that the network of capillaries is spread, in which the blood comes in contact with it. When the venous blood has returned to the heart, it is propelled from the right ventricle into the pulmonary artery. It must be remembered that this artery contains true venous blood. This artery soon divides into two, and sends a branch to each lung (*g*, *i*, fig. 54); and these ramify so as to send a minute artery along with each of the minute air-tubes, till they reach the lung-sacs already mentioned. The blood now distributes itself into capillaries on the walls of the cells and of the adjoining air-passages. The blood having in this manner come in contact with the air, and thus been rendered fit for being again sent out through the body, now passes into the first roots of the veins (so called, although they contain true arterial blood), which unite and reunite to form the four pulmonary veins that pour the blood, thus arterialised, into the left auricle of the heart, *e*, *e'*, fig. 54.

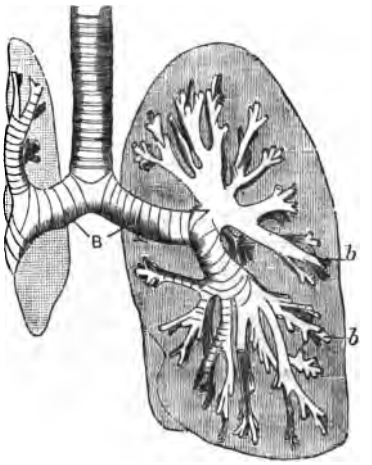


Fig. 57.

The action of the lungs is very much like what takes place on squeezing a hollow india-rubber ball in the hand, and allowing it to expand alternately. By a peculiar arrangement of the ribs, and by the contraction of the diaphragm (the floor of the chest, as it were, which, when uncontracted, rises up into the chest with a convex surface), the capacity of the chest may be very much increased. Suppose, then, the chest to be expanded; the lungs, being of a spongy nature, are also free to expand, and immediately the air rushes in through the windpipe, and fills them, just as happens when the ball is held in the open hand. But now the ribs fall, the muscles of the diaphragm relax, and the chest is contracted so as to squeeze the air out of the lungs, as happens when the hand is closed on the ball. The muscles that contract to cause these various movements act independently of the will, so that the action is kept up during sleep, which it could not be if it were voluntary.

Secretion and Excretion.

We have seen that the two functions of the blood are to deposit materials for building up and keeping in repair the different parts of the body, and to carry off the waste matter arising from the decay continually going on. The various processes by which the products of this waste are drawn off from the blood receive the general name of *secretion*;[1] and the organs for the purpose, all of which are constructed on the same principle, are called *glands*.[2] These secretions are of two kinds. One kind is merely a purification of the blood, in carrying off something which would be injurious to the system, while the other kind extracts from the blood a fluid which is intended to serve a purpose in the economy of the system. The products of the former are called *excretions*,[3] as the exhalations from the skin, urine, &c.; the products of the latter are *secretions* proper, as the saliva, gastric juice, &c. The general structure of a gland is a collection of follicles, or minute membranous bags, surrounded with a network of capillaries, from which the materials of the secretion, or the injurious substance to be excreted, are drawn. They are divided into two kinds, according to the manner in which they discharge their contents. In some cases, the secreting follicles discharge their contents separately, as the sweat glands and sebaceous glands of the skin. The work of secretion is really performed by cells or exceedingly minute bags, lining the follicles; and another form of discharge is when these cells, without being contained in follicles into which they discharge the fluid secreted, lie on the surface of a membrane, and discharge their contents upon it directly, as in the case of the mucous membranes.

In the more complicated secreting organs, such as the liver or kidneys, one or more tubes which carry off the secretion ramify in the organ into very minute branches; and at the point of each of the smallest twigs is a follicle, lined with cells, which discharge their contents into the follicles, to be carried off by the tubes.

The LIVER is the organ which secretes the bile, and is a body of a dark-brown colour, divided into two lobes, and lying opposite the stomach, on the right side. Part of the bile is sent direct from the liver to the intestine, but there is a reserve kept in the gall-bladder, a little bag attached to it. The bile is drawn from the venous blood returning from the abdomen, which is made to pass through the liver in its passage to the heart.

The KIDNEYS lie in the lumbar region, in front of the backbone, one on each side, and are imbedded in fat. The function of this organ is to

[1] From Latin *secerno*, to put aside or separate.
[2] Latin *glans*, an acorn, a gland.
[3] From Latin *excerno*, to sift.

excrete the urine, in which are carried off, dissolved in a large quantity of water, several substances which would act as poisons if left in the system.

Other secreting organs are the *pancreas*, a large oblong gland behind the stomach, which secretes the *pancreatic* juice, described under Digestion; the *spleen*, situated near the upper left-hand corner of the stomach, the function of which seems to be to act as a storehouse of nutritive material, which can be taken advantage of by the circulation, in certain emergencies of the system; and the *mammary*[1] *glands* or breasts (in women), which secrete milk for the nourishment of infants.

The Nervous System.

The functions of organic life are merely secondary and subservient to the higher or animal life. All the arrangements of the organism of the body, considered as a complete structure, are adapted to connect the Spirit of which it is the tenement with other beings and things around it—to receive sensations, to feel, to think, to will, and to act under the guidance of the mind or of instinct. For the purpose of carrying on the functions of this higher life of the human being, we find what might be called a complete telegraphic system. There is a *head*-office, to which telegraphic messages are sent from all parts of the body, telling what is going on, and asking for instructions as to what ought to be done in the circumstances; and forthwith messages are sent back with the required instructions. When one places the hand on something burning, a message immediately goes off to the head-office from the hand, that it is being burned, and back comes a message to the muscles of the arm to withdraw the hand from the dangerous spot; and it is done. Or, again, suppose a man to be crossing a street, and a vehicle to come up behind him. First, there goes a message from the ears to the head-office that there is a sound of wheels behind. At once a message is sent off to the muscles of the neck to turn the head, that the eyes may be able to report how matters stand. Probably the eyes send in a message to the effect that a cab is close behind. When this is taken into consideration in the head-office, the conclusion is come to, that it would be advisable to have the body removed out of the way as quickly as possible; and accordingly, a message is at once sent to the muscles of the legs, telling them to be active; and the visible effect is that the man jumps out of the way. This is no fanciful description; but a process similar to that here described is what actually takes place in most actions, although these may be done in an instant. Now, this telegraphic system is the *nervous system;* the head-office is the *brain;* the telegraph *wires* are an immense

[1] From Latin *mamma*, the breast.

number of nerves, or nervous fibres, spread over the surface of the body, being especially abundant in the organs of sense.

What is the nature of the connection that exists between the mind and the action of the brain, no one has yet been able to tell; we only know that there is a connection. Nor can the nature of nervous influence be explained. The nearest approach to an explanation that can be given, is to say that it acts like electricity; and, indeed, the similarity between the action of the nervous system and that of the electric telegraph is greater than at first might be supposed. When treating of the muscles, we saw that they have the power of contracting. The principal agent in producing contraction of the muscles is the stimulus conveyed to them through the nerves.

The substance of which the nervous system is composed is of two distinct kinds, called, from their appearance, *white* and *gray* matter. The white matter consists of straight fibres, lying side by side, and bound into bundles; these bundles are again bound together into larger bundles; and in this way are formed the nervous *trunks* which are spread throughout the body, and which are entirely formed of this white or fibrous matter. The gray matter is found, to a great extent, in the *ganglia*,[1] or nerve-*centres*, which are masses of nerve-matter occurring at intervals on the trunks. This gray matter is not of a fibrous texture, like the white, but consists of cells; and it seems, that in some way or other, the nerve-fibres of the trunks communicate with the cells of the gray matter in the ganglia. The office of the nerve-fibres in the trunks is to convey the influence of something going on in one part of the system to another part. These influences, as has been indicated, are sent in two directions —the impressions made on the sensitive parts of the body are conveyed to the nerve-centres, and give rise to what are called *sensations;* and when these sensations cause certain emotions, or an exercise of the will, an influence is sent outward to the muscles, which are thereby excited to contraction. And it has been proved that these different messages are conveyed by two different sets of fibres: those which carry an influence *to* the nerve-centres being called *sensitive* or *afferent;*[2] and those which carry an influence *from* these to the muscles, *motor* (because for the most part giving rise to *motion*) or *efferent.*[3]

The nervous system consists of two parts—a central part, called the *cerebro-spinal* axis, which consists of the *brain* and the *spinal cord*, lodged within the skull and the vertebral column; and an outside part, consisting of nervous trunks proceeding from the central part, and distributed to all parts of the body. The brain is composed of a number of ganglionic masses, each of which is at the head of a special department;

[1] Plural of *ganglion*, Greek, a knot.
[2] From Latin *ad*, to, and *fero*, to bring.
[3] From Latin *ex*, out from, and *fero*, to bring.

thus, each of the nerves of special sense—for example, taste, smell, &c.—has its own proper centre. The most prominent part of the brain is the *cerebrum*,[1] or, as it is also called, the *cerebral hemispheres* (because it is divided into two by a deep fissure from front to back), which, on the outside, presents the appearance of a piece of cloth crushed together in irregular folds. On the outside is a coating of gray matter, while in the inside is white matter. Behind and beneath the cerebrum is the *cerebellum*, or little brain, which is also divided into two hemispheres, and which is specially charged with the regulation of movements. From the brain, and through openings in the skull, proceed a number of nerves to the different organs about the face; and as these organs are for the most part double, the nerves go in pairs; thus, a pair of *olfactory*,[2] or smelling nerves, go to the nose, a pair of *optic*,[3] or seeing nerves, go to the eyes, and a pair of *auditory*,[4] or hearing nerves, to the ears. Besides these pairs, there are nerves to the organs of taste, and a number of others both afferent and efferent.

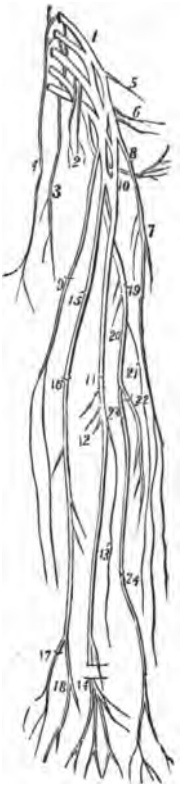


Fig. 58.

From the base of the cerebellum, the spinal cord passes down through the middle of the series of vertebræ forming the spine, sending out nerves to the trunk and limbs; and its principal function is to connect these nerves with the brain, although it has also influence of its own not dependent on the brain. The nerves springing from the spinal cord are all in pairs, arising between each pair of vertebræ, one on each side. The manner in which nerves are supplied to the extremities is through what is called a *plexus*,[5] or network. Several nerves spring from the spinal cord, and proceed together for some distance without meeting; they then divide, and branches from different nerves unite to form new nerves, and these again divide, and interchange fibres; and the nerves thus formed proceed to the extremity, as seen in fig. 58, which represents the nerves of one of the arms.

Besides the system of nerves just described, there is another set of nerves and ganglia in the body. There is a chain of ganglia, connected by nervous cords running down in front of the spine, which sends off nerves to the viscera and

1 From Greek *kara*, the head.
2 From Latin *olfactus*, the sense of smell.
3 From Greek *optos*, seen.
4 From Latin *audio*, to hear.
5 From Latin *plecto*, *plexum*, to twist or knit.

blood-vessels in the chest, abdomen, and pelvis. This system of ganglia, which seems to regulate, almost independently of the will, the processes of digestion, circulation, and respiration, its influence being little, if at all, dependent on the brain, has therefore been called the nervous system of organic life, or the *sympathetic system.*

When an impression is made on any of the nerves of the body, it carries this impression to the brain, and causes a *sensation.* The impressions made on the nerves are not all the same, however; the different kinds of sensations thus caused in the brain are classed into those of Touch, Taste, Smell, Hearing, and Sight.

Touch.

The special seat of the sense of touch is the surface of the skin. The epidermis, it will be remembered, is not sensitive; the parts really sensitive are the *papillæ,* on the outside of the *cutis,* or true skin. It is to these papillæ that the nerves are distributed on which the impressions are made by the various objects touched, and by which these impressions are conveyed to the brain. They are largest and most numerous on the palms of the hands and the soles of the feet; on the back and outside of the limbs they are much less numerous. They are small elevations, usually conical or club-shaped. Where the sense is acute, however, they have several points, from which they are called *compound* papillæ. The epidermis is also particularly thin on those parts where the sense of touch is acute, as, for example, on the tips of the fingers and lips. The papillæ are arranged in rows, and it is these rows that cause the fine ridges in the epidermis seen on the palm and fingers.

The simplest idea conveyed to our minds on touching any object is *resistance;* by the degrees of resistance we meet on touching a body, we judge whether it be hard or soft; and on moving the fingers over the surface, the impression made on the papillæ informs us whether it be smooth or rough. Were it not for our faculty of moving the hands over bodies, indeed, the sense of touch would have been of far less value than it is; for without that faculty we could not have formed our ideas of form and size.

Taste.

The seat of the sense of taste is principally, though not exclusively, on the surface of the tongue, and the arrangement is very similar to that described for Touch. The nerves of taste, like those of touch, are distributed to papillæ, in the outer membrane of the tongue. One remarkable difference in the arrangement of the papillæ of the tongue is that, instead of being concealed in its skin, they project and form the roughness of the tongue, being covered of course by the outer coat. There are

on the tongue both simple and compound *papillæ*, the former very much like those in the skin, the latter of various forms. The sense of taste is very much assisted by that of Smell, as is seen in the case of aromatic substances, the taste of which is much weaker when the nostrils are closed than when they are open. Other substances, called *pungent*, such as pepper, mustard, &c., when tasted, produce a sharp, pricking sort of sensation, which is also produced on the skin—that is, by the sense of touch—if the same substances be applied to it strongly enough. Touch and taste are thus very closely connected. It may be remarked that the sense of true touch is very acute on the tip of the tongue.

It is always necessary that the tongue be moist in order to taste anything; and it seems, too, to be a condition in substances having taste that they be soluble in water, as bodies that cannot be dissolved in water are quite tasteless.

Smell.

The seat of the sense of smell is in the cavities of the nose into which the nostrils open, and which open behind into the pharynx, or entrance to the windpipe, above the soft palate. The two cavities are separated from each other by a vertical partition, principally composed of cartilage, of which, indeed, the greater part of the framework of the nose is composed. The walls of these cavities are lined with a thick, velvety membrane, over which the olfactory nerves are distributed. It will be remembered that the outer walls are partly formed by the 'turbinated' bones (p. 45), which form three projections on each side, with hollows between. The object of this arrangement is to increase the surface over which the membrane is spread, as it is on this to a great extent that the acuteness of the sense depends. The membrane is kept continually moist by mucus, to which the particles of any substance smelt attach themselves when carried into the nostrils by the air, and thus, coming in contact with the extremities of the olfactory nerves, produce the impression which gives rise to the sensation of smell. It is on the roof of the cavity that the sense is most acute; and the effect of *snuffing up* the air is to throw the particles on that part, so as to enable us to detect odours that might otherwise escape us; although most people are unconscious of the object of this action.

Hearing.

The ear, the organ of hearing, is more complicated than any of the organs of the senses yet described. It consists of three parts—the *external*, *middle*, and *internal* ears, the last two lying in cavities in the temporal bones. The *external* ear consists of the fleshy part seen on each side of

the head, which ordinarily receives the name of ear for itself, and of the passage seen entering the head. This passage is completely closed on the inside by a membrane called the *membrane of the drum* of the ear, and behind this is the *middle* ear. The latter is a cavity filled with air, received through a tube communicating with the nose, and across which there stretches a chain of curiously shaped little bones. These bones form the communication between the membrane of the drum and one of the membranes covering the two openings into the internal ear, and their use seems to be to communicate the sound-vibrations with greater intensity than if they had been communicated direct to the inner membrane. The *internal* ear consists of three parts—the *vestibule*, the *semicircular canals*, and the *cochlea* [Latin, 'the shell of a snail']. The *vestibule* is the middle part V, and communicates with the *middle* ear by an opening covered with a membrane, to which the end of the bony chain mentioned above is attached; the other two parts are extensions of this cavity (and open into it, as into a *hall;* hence its name) chiefly for the purpose of giving a greater extent of surface for the membrane in which the fibres of the auditory nerve are distributed. The *semicircular canals* are three passages, S, in the bone, all lined with the same membrane as the vestibule. The *cochlea*, C, is a spiral canal, very like the inside of a snail-shell, and also lined with the membrane of the vestibule. The passage is divided into two by a partition running through it lengthwise. The two passages thus formed only communicate with each other at the inner end; at the entrance of the spiral, the one passage opens into the vestibule, the other into the middle ear, the latter opening being closed with a membrane. All these cavities are completely filled with a fluid, which is made to vibrate when the vibrations of the air which strike on the membrane of the drum are communicated, through the chain of bones in the middle ear, to the membrane covering the entrance to the vestibule. These vibrations act on the fibres of the auditory nerve distributed over the membrane lining the cavities; and the impressions being communicated to the brain, produce the sensation of sound.

Fig. 59.

Sight.

The organ of sight is the Eye, which is a spherical body, and composed of several protective coats on the outside, and of a delicate optical instrument in the inside. The outer wall of the eyeball is composed of three coats. The outermost coat, called the *sclerotic*,[1] 1, fig. 60, is a strong, tough, fibrous membrane, the use of which is to protect the parts inside. It does not cover the whole of the eye; the front of the eye, or that part which is visible, is covered with a transparent, *horny* or cartilaginous plate, called the *cornea*,[2] 2, which fits into the edge of the *sclerotic*, almost exactly in the way the glass of a watch fits into the case. The cornea, as may be seen from the figure, bulges out a little beyond the line of the sclerotic, or is rather more convex. The second coat is the *choroid*,[3] 3, a more delicate structure than the last, consisting almost entirely of blood-vessels and nerves. It is of a very dark colour; and it is this dark coat, seen through the narrow opening in the centre of the iris, which causes the round black spot to appear in the centre of the eye. Like the *sclerotic*, this coat also gives place to another in front of the eye; instead of the *choroid*, in front is the *iris*,[4] 6, 6, a coloured membrane, which hangs down behind the *cornea*. The use of the *iris* is to act as a curtain, to regulate the amount of light that is to be admitted into the eye; for it is contractile, and can thus diminish the size of the little hole, or *pupil*,[5] 7, when the light is too strong, as may be observed in the eye of any one looking at a strong light. The third coat is the *retina*,[6] 8, so called because it is a complete *network* of nerve-fibres from the optic nerve, 15, 16, extending all round the back part of the eye, being deficient towards the front.

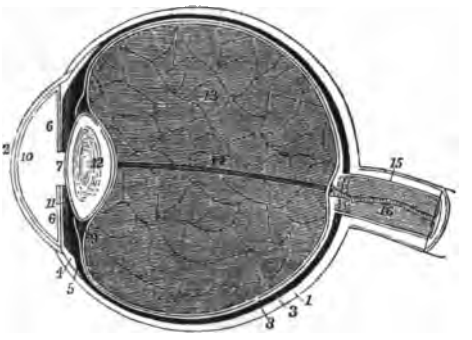


Fig. 60.

In the interior of the eye, we come first to the *aqueous humour*,[7] which is a fluid little else than pure water, filling the *anterior* chamber

[1] From Greek *skleros*, hard, stiff.
[2] From Latin *cornu*, a horn.
[3] From Greek *chŏrion*, any skin.
[4] From Greek *iris*, a rainbow.
[5] From Latin *pupillus*, a child; because, on looking into it, one sees one's own image reflected exceedingly small.
[6] From Latin *rete*, a net.
[7] From Latin *aqua*, water; *humour* is any fluid or moisture, from Latin *humeo*, to be moist.

of the eye, 10, and also the *posterior*, 11, or that part behind the iris and in front of the crystalline lens, 12. The *crystalline lens* is a humour like a thick, transparent jelly, enclosed in a transparent bag, and attached to the *choroid*, so as to keep it in its place immediately behind the pupil. As a whole, it forms a double-convex lens (OPTICS, p. 28), but with the posterior surface more convex than the anterior. Filling the whole cavity behind the crystalline lens is the *vitreous*[1] humour, a *glassy*, transparent fluid, of the consistence of thin jelly. The optic nerve enters immediately behind the eye, 2 (fig. 61), and is spread out into the retina.

All the movements of the eye are performed by six muscles: four attached directly opposite to each other, above, below, and at each side, 9, 13, 10, and 11—12; and two oblique muscles, which turn the eyes towards any of the corners. The act of thus pulling the eye *forward* is effected by these oblique muscles, 7, 8, passing through pulleys, as 6, in fig. 61. A very important appendage of the eye is the eyelid, which serves to protect the eye when closed, and also to sweep off any dust or impurity, by coming down over the eye, which it can do so rapidly as not to interfere with the sight. And in order to prevent a disagreeable rubbing in doing this, there is a fluid known as tears (when in more than an ordinary quantity), being continually poured on the upper part of the eye from the *lachrymal*[2] gland. This fluid is carried off (except when so abundant as to overflow the eyes) by a little canal which communicates with the nose. The entrance to it may be seen on the inner edge of the under eyelid, almost in the inner corner.

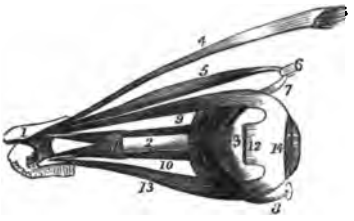


Fig. 61.

When diverging (OPTICS, p. 26) rays of light, from any point, fall on the eye, those that fall on the opaque sclerotic, or *white* part of the eye, are lost. The cornea being transparent, the rays that fall on it pass on; then those that fall on the coloured iris are absorbed, while some pass through the pupil. After traversing the aqueous humour, which probably has little effect in changing their direction, the rays strike on the crystalline lens; the latter, on account of its convexity and comparative density, has strong refracting power, and after passing through it and the vitreous humour (the function of which is chiefly to support the retina), the rays are drawn to a point, or *focus*, on the retina. When rays from all the points of a body are thus thrown on the retina, the impression conveyed to the brain is a complete image of the object.

[1] From Latin *vitrum*, glass.

[2] From Latin *lachryma*, a tear.

ZOOLOGY.

Introduction.

ZOOLOGY—from the Greek *zōon*, an animal, and *logos*, a discourse—is the branch of Natural History which treats of animals. In the largest sense of which the term is capable, it may be held to include man as part of its subject; but the term is not in general thus employed. Yet man has much in common with the lower animals; and a knowledge of human anatomy and physiology is necessary for the successful study of the structure of animals and the phenomena which life displays in them.

Of the three kingdoms of nature two are classed together as *organic*—the animal and the vegetable, the mineral being set apart as *inorganic*. Both plants and animals consist entirely of organs, and internal movements are kept up by fluids in cells and vessels, during the whole existence of the individual. It is not easy to define the term *animal*, familiar as is the idea conveyed by it. If we say that an animal is a creature having life, our definition is not perfect, for plants also have a kind of life, although we readily note a great difference between it and that which belongs to animals. When we study the lowest forms that nature presents to us in both kingdoms, it is sometimes difficult to determine to which kingdom a particular kind of creature belongs, although it is probable that our difficulty may be owing to our imperfect acquaintance with the subjects of our study, for no such difficulty is felt as to any of the higher kinds, the phenomena of whose life are better known to us. Perhaps the power of voluntary motion ought to be regarded as the true distinguishing characteristic of animals. When we think of animal life, we always associate with it the idea of *mind*—of a *will*, and *feeling*, or a capacity of pleasure and pain. To plants we do not ascribe will or feeling, even in the lowest degree. We associate no such idea even with the phenomena of irritability in the sensitive plants, or in flowers expanding under the sunshine, and turning toward the sun. If there be another distinction universally subsisting between animals and plants, it is that animals feed only on vegetable or animal substances; whereas the whole nutriment

of plants consists of inorganic substances, decomposition necessarily taking place before any organic substance can afford food for a plant.

Other peculiar characteristics of animals readily present themselves to the mind, but are not universal like these. Thus, animals are generally endowed with the power of locomotion, but some are destitute of it during the greater part of their existence. The animals with which we are most familiar all possess the senses of sight, hearing, &c.; but there are multitudes of creatures low in the scale of animal life which are destitute of these, having no brain nor manifest nervous system, and no organs of special sense, although it seems that they are generally sensible of the contact of external objects, and they manifest an avidity for food. Animals generally have a mouth and a stomach—indeed, some of the lower kinds may be described as consisting of little more, and very much resembling a bag, the mouth of which is capable of being opened and shut—but there are some which have neither mouth nor stomach, properly so called, and imbibe their nourishment through their skin at all parts of their body. The animalcules of the genus *Amœba*[1] or *Proteus*[2] resemble small masses of jelly, which seem to flow rather than crawl or glide over objects. For locomotion they protrude a portion of the substance of the body in any direction, the remainder following it. When one of them finds a particle of matter suitable for food, it envelops it, the body opening at any point to receive it, closing round it again, and retaining it till all that is capable of assimilation is extracted from it, and absorbed into the living jelly.

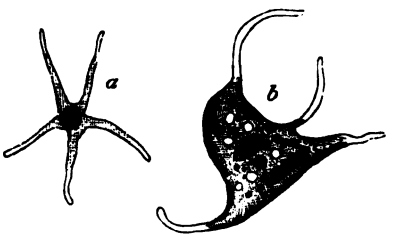


Fig. 62.—Amœba radiosa.
a, young Amœba; *b*, another specimen.

In all probability the largest animals that exist are certain species of whale; but we are acquainted with many animals so small, that their existence can only be discovered by the aid of a powerful microscope, myriads inhabiting a single drop of water, whilst there may be others still more minute, which no optical instrument yet invented enables us to discern. 'Take any drop of water from the stagnant pools around us,' says Professor Rymer Jones, 'from our rivers, from our lakes, or from the vast ocean itself, and place it under the microscope; you will find therein countless living beings moving in all directions with considerable

[1] Greek, 'vicissitude.'
[2] From *Proteus*, a being of the Homeric mythology, who sought to elude observation by continually changing his shape.

swiftness, apparently gifted with sagacity, for they readily elude each other in the active dance they keep up. . . . . Increase the power of your glasses, and you will soon perceive, inhabiting the same drop, other animals, compared to which the former were elephantine in their dimensions, equally vivacious and equally gifted. Exhaust the art of the optician, strain your eyes to the utmost, until the aching sense refuses to perceive the little quivering movement that reveals the presence of life, and you will find that you have not exhausted nature.'

Classification of Animals.

The number of different kinds of animals is very great, vastly exceeding that of plants; and the diversities amongst them are very wide, not merely in size, but in structure and habits. Classification, therefore, is absolutely necessary, in order to obtain an intelligent view of the animal kingdom; but there are some groups which at once present themselves to the observer as distinctly marked, and which therefore have been universally recognised from the earliest times. Such is the great group of Birds, or that of Fishes; although observation more exact was necessary to exclude bats from the former, and whales from the latter. The greater group of Vertebrate Animals, in which both Birds and Fishes are included, is also so natural that it must have a distinct place in every system of classification. We cannot here give an account of the various systems of classification which have been proposed. That of Cuvier has been generally received since the beginning of the present century. Cuvier regarded the animal kingdom as consisting of four great divisions —*Vertebrata, Mollusca, Articulata,* and *Radiata.* The first division, *Vertebrata* or Vertebrate Animals, consists of animals having an internal bony skeleton, the principal part of which is a back-bone or vertebral column, composed of short joints, to which all the other parts are attached. All the highest classes of animals belong to this division—Mammals, Birds, Reptiles, and Fishes. Man himself, considered as to his corporeal frame, belongs to it. All the other divisions of the animal kingdom are united under the common designation of *Invertebrata* or Invertebrate Animals; but they differ far more widely from each other than the classes of vertebrate animals, and are therefore regarded by Cuvier as forming three great groups, each equal in rank with the Vertebrata. His second division, *Mollusca,*[1] consists of animals which have no skeleton, external or internal. Their bodies are always soft and covered with a skin, and often protected by an external shell, which they secrete. Snails, slugs, oysters, mussels, cockles, and most of the other creatures popularly called *shell-fish,* belong to this division. Cuvier's third division, *Articulata*[2] or Articulated

[1] From Latin *molluscus,* soft.

[2] From Latin *articulatus,* jointed.

Animals, contains animals which, however great their other differences, have this character in common, that they are composed of segments articulated or jointed together in a line. Insects; Crustaceans, as crabs and lobsters; *Arachnids*, as spiders and mites; and *Annelids*, as leeches and worms, belong to this division. These three great divisions continue to be recognised as Cuvier established them. Not so, however, his last great primary division, *Radiata*[1] or Radiated Animals, which takes its name from the arrangement of the organs of sense and motion in rays around a centre. Cuvier placed in this division many groups of animals in which no such arrangement is to be discerned, and which differ very widely from the true Radiata. With regard to these—the lowest tribes of animals—the progress of discovery has recently been very great, consequently a modification of Cuvier's system has become necessary, and new groups have been constituted.

Protozoa.

The very lowest tribes of animals, those of most simple organisation, are now generally regarded as a distinct primary division of the animal kingdom, to which the name *Protozoa*[2] is given. With the exception of sponges, almost all the Protozoa are minute, and most of them are microscopic. Except a few that are found in the bodies of other animals, they all live in water. In general, their bodies consist simply of a mass of gelatinous matter. They have no nervous system, and therefore no organs of special sense; and none of them, except one group, have a mouth or an intestinal canal.

Rhizopoda.—Among the lowest of the Protozoa, those most remarkable for the simplicity of their organisation, or want of distinct organs, are the *Rhizopoda*,[3] a class particularly important on account of their universal diffusion, the multitudes in which they exist, and the great variety of kinds. The Amœba, already mentioned, may be regarded as a type of this class. All of them have, like it, the power of throwing out in any direction *processes* of the gelatinous substance of which they are composed, which are sometimes broad and lobe-like, but in other species are slender and of great length. The most interesting of the Rhizopoda are those which constitute the group called *Foraminifera*,[4] which are covered with a shell, and to which we owe the countless multitudes of minute fossil-shells forming great part of chalk and some other rocks, whilst the shells of still existing species abound in the sand of our sea-shores. These creatures are merely little particles of a kind of jelly; yet the shells which they produce are of the most exquisite beauty, and exhibit a

[1] From Latin *radius*, a ray. [2] From Greek *prōtos*, first, and *zōon*, an animal.
[3] From Greek *rhizon*, a root, and *pous, podos*, a foot.
[4] From Latin *foramen*, a pore, and *fero*, to bear.

wonderful regularity of structure. Their forms are extremely various, the species being very numerous. Some are simple, and of these some

Fig. 63.—Foraminifera:
1—7, Various species; 8, Part of two chambers of one; 9, Vertical Section of a fossil species.

are orbicular, others curiously flask-shaped; but many are chambered, and thus composed of parts variously arranged, sometimes in a straight line, sometimes spirally, but always regularly. These chambered shells seem to be formed in consequence of what is called *gemmation*,[1] or the growth of new individuals from an existing animal, as of buds on a tree. The shells of all the Foraminifera are pierced with numerous pores, through which long delicate *processes*—extensions of the soft body of the animal—are protruded when occasion requires.

Sponges.—Sponges, the only Protozoa that attain a large size—which they do, however, merely in virtue of the formation of aggregate or compound animals by gemmation—are perhaps the lowest of all creatures in the scale of animal life. The movements of a living sponge suggest the idea of animal rather than of vegetable life, but its form and manner of growth are plant-like. It is fixed by its base like a sea-weed; it seems utterly insensible to touch; it may even be pinched with a forceps, or torn to pieces, or bored with a hot iron, without a symptom of suffering. No wonder, therefore, that sponges should long have been regarded as plants. When the life-history of a sponge, however, is considered, its animal nature at once becomes certain. A sponge in its mature state generally consists of a horny fibrous framework, which is all we see in the

[1] From Latin, *gemma*, a bud.

sponges of commerce, and which may be regarded as the skeleton of the animal: sometimes the skeleton is formed of calcareous or siliceous needles, which are beautiful microscopic objects, admirably grouped and arranged. In a living sponge, the whole framework is covered and its cavities filled with a gelatinous or glairy substance, which is the really living part. A mature sponge is, in fact, composed of a vast number of creatures somewhat resembling Amœbæ, aggregated together, and having their framework in common. A young sponge, as it comes forth from the egg of its parent, has the faculty of moving about in the water by shooting out *processes* of its soft body, like the Rhizopoda. By-and-by, it attaches itself to some rock or other fixed substance, and becomes itself immovably fixed, ceasing to possess the power of locomotion. Its plant-like framework begins to grow, and the animal mass rapidly increases. Every one knows that the surface of a piece of sponge is perforated with a multitude of very small openings, amongst which are a number of larger ones, and that the inside is full of little cavities. In the live sponge there are currents of water continually flowing in at all the smaller openings, which are carried through the whole mass, conveying to every part of it the particles of matter which serve for nourishment, and also the air for its respiration. These currents of water are collected into canals, and pass out by the larger openings, carrying with them all the refuse, and many sponge buds, as they may be termed, which become detached from the parent, and go forth to found new colonies, as well as the eggs which are occasionally produced.

Infusoria.—The *Infusoria* are a class of Protozoa of somewhat higher organisation than the Rhizopods and Sponges. They have a mouth and a gullet, which, however, does not convey the food into a stomach, but into the general internal cavity of the body. Like the other Protozoa, they are composed of a gelatinous substance, but it is covered with a skin, and does not exhibit that variability of form so remarkable in the Rhizopoda. Many of them are also furnished with hair-like organs, called *cilia*,[1] the motion of which carries them with great rapidity through the fluid in which they live, and also creates currents to bring food to the mouth. The Infusoria often multiply by spontaneous division, and each half speedily acquires a mouth and cilia for itself. The multiplication of some Infusoria in this way is extremely rapid. One species has been observed to undergo division every twenty-four hours, from which would result 16,384 individuals in a fortnight, and 268,435,456 in four weeks. It is from the fact of their occurring in all infusions of animal and vegetable substances which stand for a short time exposed to the air, that the Infusoria receive their name. There are very many different kinds, exhibiting great variety of form and structure. Their multitudes are so

[1] From Latin *cilium*, an eyelash.

great, that leagues of the ocean are sometimes tinged with them, although they are individually so minute that the number contained in a single cup of water may exceed the whole human population of the globe.

Cœlenterata.

Superior in organisation to the Protozoa, and generally regarded as ranking next above them, are the groups which unitedly receive the name of *Cœlenterata*.[1] A great similarity of structure appears in all the Cœlenterata. Their bodies are composed of two layers, one of which forms the external covering, and the other lines the internal cavities. The body is generally soft, and has a digestive cavity with one opening or mouth, which is generally surrounded by a fringe or circle of arm-like *tentacles*[2] or *feelers*, employed to capture prey and convey it to the mouth—the first organs of prehension that have come under our notice in this survey of the animal kingdom. The mouth is not furnished with jaws, teeth, nor any organ of mastication, but the food which it receives is conveyed

Fig. 64.—Campanularia dichotoma, magnified.

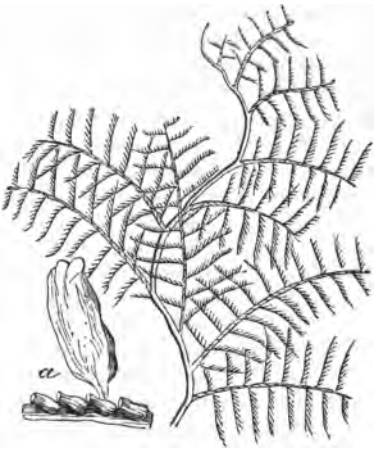


Fig. 65.—Plumularia falcata (natural size):
a, the ovarian vesicle and four of the polype-cells of *P. falcata*, magnified.

at once by a short canal into the digestive cavity. The Cœlenterata, however, are provided with other organs besides their tentacles for the purpose of obtaining prey. Deadly poisoned lances, long and slender, lie coiled

[1] From Greek *coilos*, hollow, and *enteron*, an intestine. [2] From Latin *tento*, to feel.

up in cells around their tentacles, or in some part of the outer layer of the body, and are darted out to wound and sting to death any worm or other small animal that may come within their reach. The Cœlenterata are all aquatic animals, most of them marine. Some are attached by a base to a rock or other fixed object, the mouth being at the opposite extremity, while others swim freely in the water. Many are *compound* animals, increasing by gemmation, the common stem branching in very various and beautiful forms in the different species, and the individuals—if they may be so termed—which compose the community, being arranged with as perfect regularity as the flowers of any plant. From their plant-like appearance, many of them have been called *Zoophytes*,[1] and some have, for a similar reason, received the popular names of Animal-flowers and Sea-anemones. From the circle of tentacles surrounding the mouth, many are termed *polypes* or *polypi*.[2] The common stem of many of the compound species is protected by a horny or calcareous secretion, which gives it strength to resist the action of waves and currents, and having a minute cup or cell for each polype to retire into upon the approach of danger. Coral reefs are formed by the calcareous secretions of polypes, which remain as stony masses after the polypes have died, and afford a foundation on which other polypes may proceed to build. Great tracts of country and many whole islands of the Pacific Ocean consist of coral rock, the work of these tiny and apparently insignificant animals.

The Hydra.—The polypes of the genus *Hydra* may be regarded as the type of one of the chief groups of Cœlenterata. They are inhabitants of fresh water, and may often be found adhering to stones, submerged leaves, or twigs. When not looking out for its prey, the Hydra has the appearance of a small gelatinous button; when active, it extends itself into the form of a hollow cylinder, less than an inch long, with a circle of slender tentacles round the mouth (*a*, fig. 66, represents a Hydra in this state). The body may be described as consisting merely of an outside skin and the lining of the cavity that traverses its whole length from the mouth. This cavity is all the digestive apparatus the Hydra has; indeed, its structure is so simple, that it may be turned outside in without being destroyed, for the outer layer just adapts itself to do the duty of the inner, and the inner to do that of the outer.

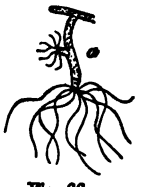


Fig. 66.

It will be noticed that on the side of the Hydra in the figure, there is a little one growing. It is thus that the young are produced by gemmation. A wart-like knob begins to grow; and as it grows it becomes more and more like the parent animal, till at last it becomes contracted where it is

[1] From Greek *zōon*, an animal, and *phyton*, a plant.
[2] From Greek *polys*, many, and *pous*, a foot.

joined to the parent, and finally is cut off altogether, and commences an independent existence.

The Actinia.—The *Actinia*, or Sea-anemone, may be taken as a type of another chief group of Cœlenterata. There are many species of Actinia, and some of them are common on the British shores. It is in tropical seas, however, that they are most numerous, and attain the greatest size and beauty. An Actinia consists of a cylindrical body, the lower end forming a disc by which the animal is generally attached to a rock or other object, whilst at the other end is the mouth surrounded by numerous tentacles arranged in circles, like the petals of a flower. Many of the Actiniæ vie with the finest flowers in the delicacy and brilliancy of their colours. When left dry by the receding tide, or when rudely touched, they contract into a jelly-like mass. In this condition, the most common British species must be familiar to every one who has gathered periwinkles, or searched for shells on a rocky shore. It is far from being the most beautiful of our British Actiniæ, but it is one of those most easily kept in the aquarium. It is capable of subsisting for a considerable time without supplies of food, but is very voracious, and readily accepts morsels of almost any animal substance. When food comes within reach of the tentacles, those nearest to it lay hold of it, and convey it not only into the mouth, but into the stomach, not letting go till it is fairly lodged there. Many animals seem to have an instinctive horror of the tentacles of the sea-anemone. The hermit crab instantly flees out of its shell, if the shell is caught by them; as any one may readily observe for himself, who, having found a sea-anemone of good size in a rock-pool, brings a hermit crab cautiously near to it.

Radiata.

The characters upon which Cuvier founded the primary division of the animal kingdom which he called *Radiata*, or Radiated Animals, may be seen in their greatest perfection in star-fishes. These creatures belong to a class to which the name of *Echinodermata*[1] is given from their generally rough or spiny integument. They are much higher in organisation than any of the groups hitherto noticed; they have a distinct digestive system, and a distinct vascular system, although for the former many of them have only a single orifice. A circular and radiating nervous system has been observed in many. They are especially distinguished from all the *Protozoa* and *Cœlenterata* by their well-organised skin, which is often strengthened by calcareous plates, and sometimes has the additional protection of numerous long spines, as in Sea-urchins; and are further characterised by their *water-vascular system*, or apparatus for *water-circulation*, a peculiarity of the radiate animals. This water-vascular

[1] From Greek *echinos*, a hedgehog, and *derma*, skin.

system is particularly connected with the organs of locomotion, which are different from those of all other animals, and are called *ambulacra*[1] (*a*, *a*, *a*, in fig. 67). They are fleshy and tubular, more or less elongated, and terminated by suckers. Their number is often very great. They pass through orifices in the external integument of the animal, and are generally arranged in rows. The movements of the ambulacra are accomplished in a very remarkable manner. Each of these organs has at its base a vesicle (*b*, *b*, in fig. 67), supplied with a watery fluid from a tube which springs from a special secreting organ (*c* in fig. 67). By the contraction of the vesicles, the fluid is forced into the ambulacra, distending them to their utmost extent; whilst on their being contracted by another set of muscles, it returns into the vesicles. A star-fish, or even a sea-urchin, can climb a perpendicular rock or the side of a glass vessel by means of this apparatus. The mouths of the Echinodermata are variously furnished with masticating organs; that of the Sea-urchins has generally five flat calcareous teeth, moved by a very complex apparatus of muscles and bony sockets, which acts as a very powerful mill for grinding down food.

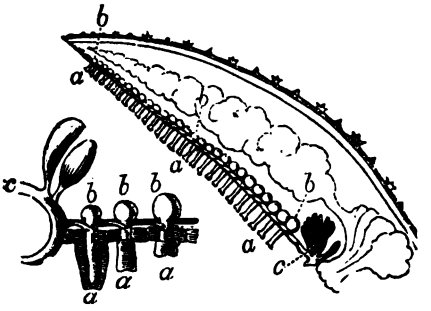


Fig. 67.—Ambulacra of Star-fish,

As seen in a longitudinal and vertical section of one of the rays; and three of them in a separate figure on a larger scale, in which they are shewn in different conditions: *a*, *a*, *a*, tubular feet; *b*, *b*, *b*, internal vesicles; *c*, the organ which supplies the fluid with which they are filled.

Articulata.

We come now to the great division of the animal kingdom called by Cuvier *Articulata* or Articulated Animals. The name refers not to the possession of articulated or jointed members, but to the articulated structure of the whole body. The Articulata are composed of segments jointed together in a line, each segment being formed of one or more rings, which in some appear externally as mere folds of a soft skin, as in worms, and in others are covered with a hard substance similar in composition to the bones of vertebrated animals, as in crabs, lobsters, &c. In some of the Articulata, the rings are almost equally developed, and the body is hardly otherwise divided into segments; in others, the rings differ

[1] From Latin *ambulare*, to walk.

very much in their development, and the segments are very distinct. A few only of the lowest Articulata, of which the earthworm may be taken as an example, have no distinct head, and no eyes nor other organs of special sense. Some of them have the mouth adapted merely for suction; but others have jaws or mandibles, and frequently several pairs of them, for seizing their food and tearing it in pieces. Their jaws do not open vertically, as in vertebrated animals, but laterally. There is no proper heart, but instead of it a *dorsal*[1] *vessel*, which runs along the central line of the body near the back or upper side. Respiration is effected by gills in those Articulata that live in water; but in those that live in air, by air-tubes, which ramify through the whole body, as in insects, or by mere air-sacs, as in the earthworm.

Annelidæ.—Many of the lowest Articulata have no limbs, but locomotion is accomplished by mere contraction and extension of the body. An earthworm, pushing its way forward, draws in the hinder part of its body as much as possible, the rings closing together, and then stretches out the fore-part as far as the integuments will permit. The earthworm belongs to a class called *Annelidæ* or *Annelids*, from Latin *annulus*, a ring. They have all very much the same form, and none of them have limbs, but many, higher in the scale of organisation than the earthworm, have eyes, and some have feelers or tentacles. Most of them live in water and respire by gills.

Leeches belong to an order of Annelids differing from all the rest in their mode of locomotion, which is by means of suckers, one at each end of the body. The sucker at the fore-end of the body is also the mouth; and that of many species is admirably adapted not only for killing and eating the minute aquatic animals which constitute their ordinary food, but for making little wounds in the higher animals, when opportunity occurs, through which their blood may be sucked.

Myriapoda.—Next to the Annelids may be ranked the class called *Myriapoda*,[2] in which the same elongated form generally prevails, and the body is, in like manner, composed of a large number of almost equal rings. All the Myriapoda, however, have a distinct head, most of them have eyes, and they have *antennæ* like those of insects. The mouth is furnished with a complete masticating apparatus. The body is protected by a hard covering, or external skeleton. None of the Myriapoda have wings. They do not undergo so great transformations as insects, but issue from the egg somewhat like what they are ultimately to become. The higher kinds of Myriapoda, as Centipedes, feed on animal substances, or prey on small animals; the lower, as Gallyworms, generally feed on decaying vegetable matter.

[1] From Latin *dorsum*, the back.

[2] From Greek *myrios*, ten thousand, and *pous*, *podos*, a foot.

The organs called *antennæ* are jointed filaments with which the head is furnished, one on each side, and are evidently very delicate organs of touch. The creatures which possess them seem to feel their way by them, and to them is ascribed the bee's power of working in the dark. Some suppose that they are also organs of hearing, and by means of them it would appear that some insects, as bees and ants, have the power of communicating with each other. They possess great flexibility, but differ much in the number of joints of which they are composed, and also in their form, some being threadlike, some club-shaped, some feathered, &c. in endless variety.

Crustacea.—The remaining classes of Articulata—namely, *Crustacea*, *Arachnida*, and *Insecta*—all have the body generally less elongated than the *Annelidæ* and *Myriapoda*, the division into segments quite distinct, and the circulating and nervous systems much concentrated in those segments with which the organs of special sense and of locomotion are connected. All of them have articulated limbs, and Insects are also very generally furnished with wings, which neither Crustaceans nor Arachnids possess. The *Crustacea* derive their name from their external skeleton, the hard armour which in most of them covers the whole body, and which, in those of highest organisation, is very complex in its structure. The body in Crustaceans, as in Arachnids and Insects, consists of three segments, the head, thorax, and abdomen. In Crustaceans and Arachnids, the head and thorax are very much combined into one piece, whilst in Insects they are perfectly distinct. All the organs of special sense are connected with the head, and the limbs with the thorax; but in many Crustaceans, as the lobster, prawn, and shrimp, the principal organ of locomotion is the abdomen, which terminates in fan-like appendages. By bending the abdomen suddenly down under the thorax, they dart backward in the water. The limbs of some are adapted for swimming; those of others are used for walking at the bottom of the water or on dry ground. The first pair of legs is not unfrequently transformed into powerful claws or pincers, as in crabs and lobsters. The limbs of the first thoracic rings are, in many Crustaceans, organs not of locomotion, but connected with the mouth, and employed for tearing food. The respiratory organs of all the Crustaceans are adapted to an aquatic life; even those which live on land being generally inhabitants of damp places and breathing by means of gills. Crustaceans are all oviparous; and they undergo remarkable metamorphoses after issuing from the egg, before they attain their adult form, after which, however, they still increase in size, *moulting* or casting the shell frequently.

The minute Crustaceans, which abound in lakes, ponds, and rivers, as well as in the sea, are of great use in the economy of nature, consuming

organic matter which would otherwise pollute the water by its decay, and affording food for fish.

Arachnida.—The *Arachnida* are commonly regarded as intermediate between Crustaceans and Insects. They have generally eight legs; although some, like insects, have only six. None of them have wings. The higher kinds—spiders and scorpions—breathe by means of pulmonary cavities; the lower—mites and ticks—by air-tubes. All of them have two or more eyes; many have eight. Some of the lowest Arachnida are parasitic upon insects, and a few live on decaying animal or vegetable substances, of which we have an example in the cheese-mite. In this and other mites and ticks, the mouth is a mere proboscis formed for suction; but spiders and scorpions have a mouth fitted for tearing and masticating their prey. Scorpions are remarkable for the sting at the tip of the tail, the tail itself being a prolongation of the abdomen. Spiders also subdue their prey by means of poison; but it is emitted through the mandibles. Both spiders and scorpions prey chiefly on insects; but there are very large spiders in the tropical parts of South America which occasionally prey on small birds. Many spiders catch their prey by stealthily approaching it, and suddenly springing upon it; but others employ *webs* for this purpose, the spider lurking in a corner of the web till the vibrations of its threads announce that an insect is entangled in its meshes. Spiders' webs are formed of a substance exuding from small protuberances called *spinnerets*, at the extremity of the abdomen. This substance is at first glutinous, but dries into thread as soon as it comes into contact with the air.

Insecta.—Insects,[1] so named from the extremely marked division of the three segments which form the body, are the most important and numerous class of Articulata. The segments are often so deeply divided that the slenderness to which the body is reduced between them cannot be contemplated without admiration, as in the neck of a wasp, or in the link which connects its abdomen with its thorax. The first segment is the *head*, which may be regarded as formed of several rings, modified and condensed together till their character as distinct rings is lost. The second segment is the *thorax*, which is always formed of three rings, closely combined, but easily distinguishable. The third segment is the *abdomen*, usually consisting of nine rings. All insects in their adult state have six legs; some are destitute of wings; others have two, and others four; but no insect, and indeed no animal, has any other number, and the only animals having four wings are insects. The external covering of the body of insects is of a horn-like substance, in most parts hard, but more or less flexible. It is the principal framework of the body, and to it the muscles are attached. Respiration is extremely

[1] Latin *insecta*, cut into, from *in*, into, and *seco*, to cut.

active in insects; and they display, in general, an extraordinary degree of activity and muscular energy. The flight of many kinds is far more rapid, in proportion to their size, than that of birds; others display a similar superiority in running, swimming, and digging or burrowing; whilst the leaping of many, as fleas and grasshoppers, and the springing of others, as cheese-hoppers, greatly exceed that of which any vertebrate animal is capable.

Insects feed on very different kinds of food. Some prey on other insects; some devour animal, and some vegetable substances; some suck the juices of animals, some the juices of plants or the honey of their flowers. The mouth of many is adapted for gnawing, cutting, or tearing; that of others, for sucking. An insect's mouth of the former kind is very complex in structure; and although the mouth adapted for sucking is apparently much more simple, it in reality consists of the same parts, but very much modified and united. The eyes of insects are of two kinds—*simple* and *compound*. Some have simple eyes only, others have only compound eyes; but the greater number have two large compound eyes on the sides of the head, and three small simple eyes between them. A compound eye is an organ of most remarkable structure. When examined through the microscope, its surface is seen to be divided into a great number of hexagonal facets, which are in fact *corneæ*. In the ant, there are only about fifty of these facets in each eye; but in the common house-fly, there are about four thousand, in butterflies, upwards of seventeen thousand, and in some beetles, more than twenty-five thousand. Each cornea may be regarded as belonging to a distinct eye, provided with a nervous apparatus, lens, iris, and pupil of its own. The eyes of insects cannot be turned to one side, like those of vertebrate animals, and for the want of this power, compensation is made by the number of eyes, each looking in its own particular direction.

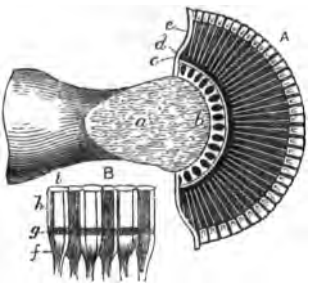


Fig. 68.—Section of the Eye of a Cockchafer (highly magnified):

A, section: *a*, optic ganglion, into which the optic nerve swells; *b*, nerves arising from its surface, and proceeding to the general retina; *c*, general retina; *d*, layer of pigment, in front of the general retina; *e*, optic nerves of the individual eyes which form the compound eye. B, a group of these, much magnified: *f*, bulb of optic nerve; *g*, layer of pigment; *h*, vitreous humour; *i*, cornea.

Insects, in general, take no care of their eggs after depositing them; but they are guided by wonderful instincts to select the proper situations for the deposition of them, so that the young, when hatched, may

find suitable food, although this food is often a kind quite different from that of the insect in its adult state. Some insects, however, as bees, wasps, ants, and earwigs, pay great attention to their young. The stage of development at which insects issue from the egg is very different in different tribes. In general, however, they undergo very remarkable metamorphoses. A worm, inhabiting a muddy pool, becomes a winged creature that sports in the air; a crawling caterpillar, that greedily devours some kind of herbage with its horny jaws, eating vastly more in proportion to its size than an ox, is converted into a splendid butterfly, flitting from flower to flower, and feeding only on nectareous juices. The first stage of insect-life, after the egg is hatched, is called the *larva*[1] stage, and in this the young insect generally increases much in size. Caterpillars are the larvæ of butterflies, moths, and hawk-moths; grubs are the larvæ of beetles; maggots are the larvæ of two-winged flies, such as the house-fly and blow-fly. The next stage into which insects pass is the *pupa*[2] stage, in which those that undergo *complete* metamorphoses are almost quite inactive, and take no food. The pupa of a butterfly, a moth, or a hawk-moth is called a *chrysalis*[3] or chrysalid, from the golden spots with which many such pupæ are adorned. Chrysalids are often enclosed in a horny membranous case. Many larvæ, when about to change into the pupa state, spin *cocoons* or silken envelopes in which they undergo their transformation, and which serve for the protection of the inactive and helpless pupæ. Silkworms are the larvæ of certain species of moth, which, on undergoing their transformation into pupæ, spin for themselves cocoons, the thread of which is *silk*. The cocoon of the common silkworm exhibits externally a loose gauze-like covering, within which is a compact and close oval ball; yet all this is one continuous thread, which may sometimes be unwound to the length of one thousand feet. The perfect insect is formed within the covering of the pupa, attaining there its full proportions, and ready to use its wings, its legs, and all its other organs within a few moments after it has emerged into the open air.

Fig. 69.—Purple Emperor Butterfly: The larva and pupa or chrysalis are shewn below—the larva to the right, and the chrysalis to the left.

1 Latin *larva*, a mask. 2 Latin, 'a doll.' 3 From Greek *chrysos*, gold.

Insects are all animals of small size. The largest are tropical, amongst which are butterflies of almost a foot across the expanded wings. Insects abound far more in warm than in cold climates. The different species are very numerous, those of beetles alone exceeding in number all the kinds of vertebrated animals.

A few species of Insects are important for their usefulness to man; but a far greater number are remarkable for the injuries they inflict by the destruction of herbage and crops or of articles of food or raiment. Of noxious insects, locusts may perhaps be regarded as the chief. Of insects useful to man, bees and silkworms deserve to be first named, and after them the cochineal insect and blistering-flies. There are a few others to which we are indebted for substances useful in medicine and the arts.

The instincts and habits of insects are very various and interesting. Many volumes have been written on those of bees and ants alone.

Of the orders into which the class of Insects is divided by systematic naturalists, we must be contented with very briefly noticing only the most important. Taking first the insects which undergo complete metamorphoses, and in their perfect state have the mouth fitted for gnawing, tearing, and masticating, we find the order *Coleoptera*,[1] distinguished by having the first pair of wings modified into hard sheaths —called *elytra*, or wing-cases—to cover the second pair when not in use, and to protect the upper side of the abdomen, the wings being folded crosswise under these wing-cases. Coleopterous insects are sometimes collectively called *beetles*, although many of them are familiarly known by other names, as chafers, weevils, lady-bugs, &c. The glowworm and fireflies belong to this order, as do also the valuable cantharides, or blistering-flies.—The order *Orthoptera*[2] differs from Coleoptera chiefly in having the wing-covers of a soft substance, somewhat resembling parchment, and the wings folded longitudinally in a fan-like manner. To this order belong locusts, grasshoppers, and crickets; also those curious insects which, from their resemblance to leaves, twigs, and other objects, are known as leaf-insects or walking-leaves, walking-sticks, &c.—The order *Neuroptera*[3] consists of insects having mouths similar to those of the orders already noticed, and four nearly equal and membranous wings, all adapted for flight, not folded in any way when at rest, and divided by their nervures—ribs or veins—into a delicate network. To this order belong dragon-flies, may-flies, ant-lions, and termites or white ants. These last-named insects have social habits resembling those of the true ants. The great ant-hills of Africa and South America are constructed by them.—The order *Hymenoptera*[4] contains a vast number of

[1] From Greek *coleos*, a sheath, and *pteron*, a wing.
[2] From Greek *orthos*, straight, and *pteron*, a wing.
[3] From Greek *neuros*, a nerve or string, and *pteron*, a wing.
[4] From Greek *hymen*, a membrane, and *pteron*, a wing.

species, among which are ants and bees. They have the mouth furnished with mandibles for cutting and tearing, but other parts of it formed for suction. The wings are four in number, membranous, not folded when at rest, the first pair larger than the second, the wings of the same side united in flight by little hooks. Many species of this order have stings, and they are the only insects which have.

Among the orders of insects which undergo complete metamorphoses, but, in their perfect state, have the mouth formed only for suction, the first that demands notice is the order *Lepidoptera*,[1] to which butterflies, moths, and hawk-moths belong. The mouth has a long trunk, coiled up when not in use; the wings are four in number, membranous, and covered with minute closely set scales, of very various forms. Great beauty appears in the whole order.—The order *Diptera*[2] contains all the two-winged insects commonly known as *flies*, also midges, gnats, &c. The number of species is immense. The mouth is formed for suction alone.

The insects which undergo no metamorphosis are comparatively few. They are all destitute of wings. Many of them are parasitical on other animals.

Mollusca.

Coming now to the primary division of the animal kingdom called *Mollusca*, we return to the consideration of animals far lower in organisation than those which have last been under notice, and ascend as by a new path to higher tribes; for there is not in nature a regular unbroken gradation, as some have fancied, from the lowest to the highest forms of animal life. But in the highest Mollusca we have a nearer approach than in any of the other animal sub-kingdoms, to the highest of all, that of *Vertebrata*. Many of the lower Mollusca—those forming the order *Polyzoa*[3]—were until recently ranked among Zoophytes, and they have a strong general resemblance to the polypes already noticed as belonging to the great group of *Cœlenterata*. They are, like them, of minute size, and many have a similar coralline fabric. They also resemble them in multiplying by gemmation and forming compound animals. In the lowest groups of Mollusca, we find only one principal nervous ganglion. In the higher groups, there are several ganglia lying somewhat irregularly in different parts of the body, and communicating by nervous threads with a larger mass. It is only in the highest Mollusca that a distinct head is found, bearing organs of special sense. The lowest groups have no distinct heart, but all the higher possess it. The bilateral symmetry of form, almost universal in articulated and in vertebrate animals, is comparatively

[1] From Greek *lepis*, a scale, and *pteron*, a wing.
[2] From Greek *dis*, twice, and *pteron*, a wing.
[3] From Greek *polys*, many, and *sōon*, an animal.

rare in the Mollusca. The shell with which many species are protected, has not in the least degree the nature of an external skeleton, no muscles being attached to it but those which are necessary for the opening and shutting of its own valves. It is a mere calcareous exudation from the *mantle*, a thick, soft, flexible skin, with which, in all the Mollusca, the whole body is invested. Many Mollusca have no shell; many have the shell in a single piece, which is often a spiral tube closed at one end, and gradually widening to its open extremity. Such shells are called *univalves*.[1] Snails, whelks, and periwinkles afford familiar examples of the most common form of univalve shells. Somewhat different forms may be seen in limpets, cowries, &c. The shells of many molluscs are composed of two valves, as those of oysters, mussels, &c., which the animal is able to open and shut at pleasure. Such shells are called *bivalve*.[2] In a small number of molluscs, the shell is composed of a greater number of pieces, and such shells are said to be *multivalve*,[3] but the multivalve molluscs differ little from univalves in their general organisation.

All molluscs have the power of locomotion, at least in the earliest stage of their existence; although many of the lower tribes soon lose it, and become permanently fixed in one spot. The modes of locomotion are various. Many molluscs move by means of a muscular structure in some particular part of the mantle, termed the *foot*, which in some, as in the cockle, is an organ for springing, in others for burrowing, in many for crawling, and in some for swimming. In the highest of all orders of molluscs, the *Cephalopoda*[4]—of which the cuttle-fish and squid are examples—the head is furnished with tentacles armed with suckers, and by means of these the animal drags itself along, whilst the body is also often provided with fin-like expansions, which serve for swimming. The respiration of Mollusca generally takes place by gills; but slugs and snails, which do not inhabit water, have a pulmonary sac or cavity lined with a vascular network.

Vertebrata.

The highest primary division of the animal kingdom is that of *Vertebrata*, comprising the five classes of Fishes, Amphibians, Reptiles, Birds, and Mammals, the first-named being the lowest, and the last the highest of all. All the classes of Vertebrata agree in what may be called a general type of structure, exhibited in its highest perfection in man, and of which some account has already been given under

[1] From Latin *unus*, one, and *valva*, a valve.
[2] From Latin *bis*, twice, and *valva*, a valve.
[3] From Latin *multus*, many, and *valva*, a valve.
[4] From Greek *cephalē*, the head, and *pous, podos*, a foot.

PHYSIOLOGY. One of the most marked characteristics of the vertebrate animals is that indicated by their common name; they have an internal bony skeleton, to which the muscles are affixed, and of which the principal part is the backbone, terminated at the anterior extremity by the skull. They have in general four limbs, corresponding to the arms and legs of man, but very variously modified as organs of mere locomotion, and as organs also of prehension; and assuming not only the characters of arms and legs, terminated by hands or feet, but also of fins, wings, &c. Some vertebrate animals have only one pair of limbs instead of two, a few have no limbs at all. No vertebrate animal has any other number of limbs than two or four. The limbs are always formed of bones jointed to the backbone and one to another, surrounded with muscles, and covered with skin. All vertebrate animals have a distinct head, a skull containing the brain, and a spinal cord extending through the centre of the backbone. They have a system of circulation dependent on the action of a muscular heart with two or more cavities. Those which live in water breathe by gills, those on dry land by lungs. The digestive system, although exhibiting a variety of modifications as great as the external form, presents always the same general characters. The mouth, for example, is always situated in the front of the head, and has two bony jaws articulated to the other bones of the head. A tongue is also always present in the mouth, an organ to which nothing truly corresponding is to be found in any invertebrate tribe.

Fishes.—The class of Fishes consists of animals that all live in water, and at all stages of their existence breathe by gills. In number—both of individuals and of different kinds—fishes are supposed to exceed all other vertebrate animals together. Not only the sea, but lakes and rivers abound in them, even the waters of hot springs and the pools of caverns have their peculiar species. Their form is adapted to easy progression through water. The four limbs which belong to the vertebrate type are generally all present, assuming the form of fins —the first pair, situated on the *breast*, being the *pectoral*[1] fins (*p*, fig. 70), and the second the *ventral*[2] (*v*, fig. 70), their normal position being on the *belly*. The latter are liable to great changes of position, and are often found close under the pectoral fins, and sometimes before them, quite on the *throat* of the fish, in which position they are called *jugular*[3] fins. Fishes, however, have also other fins, not so closely connected with the proper skeleton, and placed singly on the middle line, both above and below. One of these, the *caudal*[4] or tail fin (*c*, fig. 70), is the principal organ of locomotion, the whole muscular power of great part of the

[1] From Latin *pectus*, the breast.
[2] From Latin *venter*, the belly.
[3] From Latin *jugulum*, the throat.
[4] From Latin *cauda*, a tail.

body being brought to bear in its stroke. The fins on the *back* are called *dorsal* fins (fig. 70, d^1, first dorsal; d^2, second dorsal), and that behind the anus, the *anal* fin (*a*, fig. 70). Fishes differ from all other vertebrate animals in having sets of bones not connected with the backbone or the internal skeleton. These bones support the vertical fins, and are thickest at the skin, from which they penetrate towards the vertebræ. Fishes consume little air in respiration, and are *cold-blooded* animals, having in general a temperature little above that of the water in which they live.

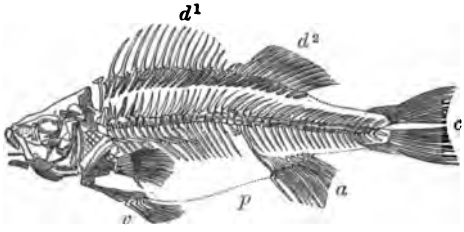


Fig. 70.—Skeleton of a Fish.

The mouth of fishes is their only organ of prehension. In some it is extremely small, in others extremely large; in some destitute of teeth, in others furnished with a multitude of very minute teeth, in others, again, with a great number of large and strong teeth. In some, as lampreys, it forms a sucker, by which the fish can both affix itself and suck up the blood of the animal on which it preys. The teeth of fishes are more various in number, form, and position than those of any other animals. Some fishes feed on vegetable food, such as the leaves of water-plants; but most of them feed on animal food, of which there is no kind that does not seem to be particularly agreeable to some of them.—Fishes are generally oviparous, and the multitude of their eggs is prodigious, as may be seen in the roe of a herring or a cod; a few kinds are *ovoviviparous*,[1] the eggs being hatched within the body of the parent, and the young produced in a living state.—Fishes are generally covered with scales, which are variously formed and arranged. Some kinds have large bony plates instead of scales.—Of the uses of fishes to man, by far the most important is that of supplying him with food. It is impossible here to enumerate the fishes highly valuable in this respect. Some of them are to be found inhabiting both salt and fresh waters, in all parts of the world. The herring, cod, and salmon are, however, the three species of highest economical importance.

Fishes are divided into two great sections or sub-classes—Osseous[2] Fishes, which have hard bones, and Cartilaginous Fishes, of which the bones are cartilaginous, and destitute of true bony fibres. The Osseous Fishes are far more numerous than the Cartilaginous; the

[1] From Latin *ovum*, an egg, and *viviparus*, bringing forth its young alive.
[2] *Bony*, from Latin *os*, a bone.

most important of the latter section being the tribes of Sharks, Rays (Skates, &c.), Sturgeons, and Lampreys.

Amphibians.—The class *Amphibians*[1] receives its name from the fact that many of the species belonging to it are capable of living either on dry land or in water. Many naturalists regard it merely as an order of the class of Reptiles, to which the name of *Batrachian*[2] *Reptiles* is given, the *frog* being taken as the type of the whole. The most essential differences between Amphibians and Reptiles are, that young Amphibians undergo metamorphoses, and that Amphibians breathe by gills alone in the earlier part of their life, whilst in their adult state most of them breathe by lungs alone, although some have both lungs and gills. Most of the Amphibians, in an adult state, have four limbs, although in some these are altogether wanting, and others have only one pair; but in the early stages of their life none of them have limbs at all, and their form is fish-like, of which we have a familiar example in the tadpole, the young of the frog.

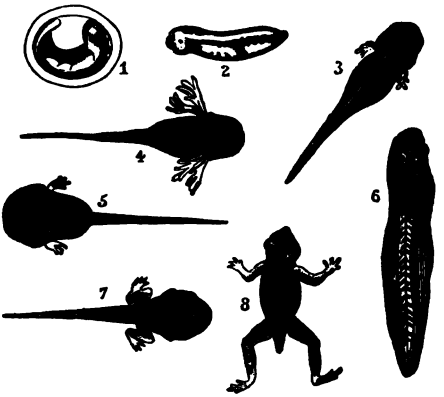


Fig. 71.—Successive stages of the Frog:
In the order of the numbers—from the egg almost to the perfect form.

Frogs, toads, newts, and salamanders are the best known Amphibians; but some of those of other countries greatly exceed those of Britain in size.

Reptiles.—*Reptiles*[3] agree with Amphibians and Fishes in being cold-blooded. They differ from Amphibians in breathing by lungs throughout the whole period of their existence. Three orders of reptiles are generally

[1] From Greek *amphibios*, having a double life.
[2] From Greek *batrachos*, a frog.
[3] From Latin *repo*, to creep.

recognised by naturalists: *Ophidians*[1] or Serpents; *Saurians*,[2] including lizards, crocodiles, and all species of lizard-like form; and *Chelonians*,[3] containing tortoises, turtles, &c.

SERPENTS have no limbs, and in general the body is very much elongated. The body and tail are covered with scales, the head very often with plates. The vertebræ and ribs are extremely numerous, some serpents having more than three hundred pair of ribs. A serpent moves by means of its ribs and the scales of the abdomen, which are joined to the ribs by slender cartilages, and take hold of the surface over which the animal passes. Many serpents not only glide over the ground with great rapidity, but climb trees with comparative ease. The vertebræ are so formed and jointed together as to give great pliancy to the body. Serpents abound chiefly in the warm parts of the world, to which also the largest species belong, and those of which the venom is most deadly. Venomous serpents depend on their poison-fangs for the capture of their prey. The fangs are a pair of tubes firmly fixed into a movable bone in the front of the upper jaw. When not in use, they are laid back on the roof of the mouth; but when the animal is irritated, and about to assail its enemy or its prey, they stand out like two lancets. Above them, towards the back of the head, is a large gland for the production of the poison, which passes down the fangs into the wounds which they make. Many serpents, however, are not venomous, but depend on other means for catching their prey, some feeding chiefly on insects or very small animals; and some, the largest and most powerful of all—as the *Boa-constrictor* and the *Pythons* of the East Indies—killing even large quadrupeds by mere muscular effort when they have laid hold of and coiled themselves around them.

LIZARDS may be regarded as exhibiting the perfection of the Saurian type. In them, and in chameleons, iguanas, &c., the body is covered with scales; but in crocodiles and alligators it is covered with bony plates, and these animals have therefore been separated from Saurians by some naturalists, and constituted a distinct order under the name of *Loricata*.[4] They are all large reptiles, much larger than any of the scale-covered Saurians, and formidable from their strength and voracity. They inhabit the lakes and rivers of warm countries. The scale-covered or true Saurians are also chiefly inhabitants of warm countries, and most of them love dry situations and sunshine. Some climb trees, and generally live in them, pursuing there their insect prey. A few of them, as the *Iguana* or *Guana* of the West Indies, feed on leaves and fruits. The

[1] From Greek *ophis*, a serpent.
[2] From Greek *sauros*, a lizard.
[3] From Greek *chelonē*, a tortoise.
[4] That is, *mailed*, from Latin *lorica*, a coat of mail.

Iguana, although of repulsive appearance, is highly esteemed as an article of food, and is the only Saurian reptile which is so used, except by savage tribes.

Very different from all other reptiles in structure and general appearance is the last order, that of CHELONIANS, all of which are popularly known by the names of tortoise and turtle—the tortoises being those which live on land, and have their feet adapted chiefly for walking; the turtles, those which live in water, and whose limbs are mere paddles for swimming. The Chelonians are all inhabitants of warm countries. Their numbers in some places are astonishingly great. The species both of tortoises and turtles are very numerous, and some of them are highly esteemed for food. The useful substance called tortoise-shell is the hard covering of animals of this order. This covering is really bony, and therefore differs from the outer covering of all other vertebrate animals, being formed from the ribs, the vertebræ, and the breast-bone expanded into plates, and firmly jointed into each other, so as to acquire great solidity, particularly in tortoises, and give most perfect protection to creatures which have no other means of defence. Tortoises feed exclusively on vegetable food, but some of the aquatic Chelonians pursue and prey upon other aquatic animals. The jaws of Chelonians are not furnished with teeth, but are hard, sharp, and horny; they act in a manner somewhat resembling the mandibles of birds. All the Chelonians are oviparous. They lay a great number of eggs, which are covered with a calcareous shell like those of birds, whereas those of other reptiles have only a parchment-like covering. The eggs of turtles are a favourite luxury in the countries in which they can be obtained.

Birds.—Birds are the highest class of oviparous animals, and the only class having warm blood. They exhibit a great similarity in their general structure, and differ very widely in appearance and characters from every other class of animals. To this class belong all the vertebrate animals which are capable of true flight, except bats. The fore pair of limbs in birds serve them only as wings, never in any degree as arms or legs; those few birds in which they are too small to raise the body in the air, generally employ them to aid their swift running upon land, as the ostrich, or for swimming *under* water, as penguins, which in this manner pursue fish. The body of birds is covered with feathers, and this is one character in which all birds agree, and in which they differ from all other animals. The jaws of birds are much elongated, so as to form the bill, the organ chiefly used in seizing food. The bones of the wing are essentially the same with those of the arms of man, but very much modified to accommodate them to their different use. The bones which represent the fingers are much condensed and partially obliterated. The surface

necessary for striking the air is provided by feathers different from those of other parts of the body, called *wing-feathers* or *quills*. In many birds, similar feathers appear in the tail, which is used for governing flight. The mechanical adjustments by which the wings are fitted for use as organs of flight, are very beautiful. Birds do not rise or sustain themselves in the air because of any special lightness of their bodies, which are in fact much heavier than the air, but by the action of their wings upon it, and its resistance to them. The legs of birds consist of parts corresponding to those of the legs of man, but the thigh is short, and concealed within the body, the apparent thigh corresponding to the human leg, and the *shank*, which serves the bird as a leg, to a part of the foot.—Some birds are very useful to man, as affording, in their flesh and their eggs, valuable articles of food; but the number really of importance in this respect is very small in comparison with the multitude of species, and the useful kinds belong mostly to two orders, *Rasores* and *Natatores*, to be presently noticed.

We can only indicate in a few sentences the orders of birds. The order *Accipitres*,[1] *Rapaces*,[2] or *Raptores*,[3] contains birds of prey, the food of which is the flesh of animals, chiefly other birds and quadrupeds. They are characterised by great strength of claws and bill. The upper mandible of the bill is hooked and sharp. The claws also are generally hooked and sharp, and the feet formed for seizing prey. The wing is generally large and pointed. This order is divided into two groups, *Diurnal* and *Nocturnal*, the first containing eagles, falcons, hawks, vultures, &c.; and the latter consisting entirely of owls. —The order *Insessores*[4] is a very large one, consisting of birds which have weak, slender feet, not adapted for seizing prey, but generally for perching on trees. Like the Birds of Prey, and most of the birds of other orders, they have four toes, three directed forward, and one backward. The bill is weak and little curved. The wings are of moderate size, and generally rounded. Some of the Insessores feed chiefly on insects, some on seeds or fruits, some indifferently both on animal and vegetable food. To this order belong crows, thrushes, linnets, larks, sparrows, humming-birds, birds of paradise, &c.—The order *Scansores*[5] consists of birds very similar to Insessores, but having two toes behind and two before, so that their feet are peculiarly adapted for grasping and climbing. Parrots afford perhaps the best example of this order. Woodpeckers also belong to it. —The *Rasores*,[6] or Gallinaceous Birds,[7] have a bill of moderate size, short wings, a heavy body, weak toes, and short, stout claws. In general,

1 Latin, plural of *accipiter*, a hawk.
2 Latin *rapax*, rapacious.
3 Latin, plural of *raptor*, a seizer or plunderer.
4 Latin, 'sitters,' from *sedeo, sessum*, to sit.
5 Latin, 'climbers,' from *scando, scansum*, to climb.
6 Latin, 'scrapers,' from *rado, rasum*, to scrape.
7 From Latin *gallus*, a cock.

they have little power of flight, and seek their food on the ground. Many do not even perch on trees. They derive their name Rasores from their habit of *scraping* the ground in search of worms and insects, a habit which is scarcely found in any other birds. To this order belong the common fowl, the turkey, pheasant, quail, partridge, grouse, &c. Pigeons are also generally ranked in it.—The order *Cursores*[1] is a very peculiar one, distinguished by the shortness of the wings, which are not adapted for flight, and by long and strong legs, suited for rapid *running* on the ground. The species of this order are few; but all are birds of large size. The ostrich, cassowary, and emu belong to it.—The *Grallæ* or *Grallatores*,[2] are birds with long shanks and long toes, adapted for wading or for walking on sand or mud. The whole figure is generally slender; the neck often long. Many birds of this order have also long bills. Some of them feed on vegetables; others on insects, molluscs, small fish, &c. Most of them inhabit marshy places or the banks of rivers and the sea-shore. Some seek their food by inserting their long bills into mud. Herons, cranes, storks, bitterns, snipes, and woodcocks are examples of this order.—The order *Natatores*[3] is characterised by webbed feet, that is, by having the toes connected by a membrane, so as to be especially adapted for *swimming*. The bill varies very much in form, according to the habits and food of different kinds. Some, as penguins, have very short wings; others are long-winged birds of very powerful flight, as albatrosses, petrels, and other oceanic birds. Swans, geese, and ducks belong to this order; also gulls, terns, and sea-fowl in general.

Mammalia.—*Mammalia* or *Mammals*[4] are the highest class of animals. In them the brain assumes its most perfect form, and the highest degrees of intelligence are displayed, although in these respects there is much diversity in the different groups, the greatest perfection being reached in man, who, considered with regard to his mere animal nature, must be ranked in this class. The name refers to a characteristic of the class altogether peculiar to it, that the females *suckle* their young. All the Mammalia are viviparous, although the young are produced in very different stages of development. The skin of the greater number of mammals is covered with hair, a kind of covering peculiar to this class of animals. The limbs of some species are adapted merely for locomotion and for the support of the body; those of others are also organs of prehension. Marine species have them modified into paddles; and in the *Cetacea* (whales, &c.) the fore-limbs are represented by fins, whilst the hinder limbs are altogether wanting.

The class Mammalia is divided into three principal sections, according

1 Latin, 'runners,' from *curro*, *cursum*, to run.
2 Latin, 'stilt-walkers,' from *grallæ*, stilts.
3 Latin, 'swimmers,' from *nato*, *natatum*, to swim.
4 From Latin *mamma*, a teat.

to the character of the limbs and of their extremities—*Unguiculata*,[1] mammals having nails or claws; *Ungulata*,[2] mammals having hoofs; and *Mutilata*,[3] mammals having no hind-limbs, and the fore-limbs modified into fins. To the first of these sections, Unguiculata, man is referred; and for the single species so high in intelligence and endowments, so different from all other animals, the order *Bimana*[4] has been constituted, the name expressing the peculiar character of the adaptation of the extremities of the fore-limbs to the purposes of grasping, &c., as hands; whilst those of the hind limbs are merely feet, serving for the support of the body; this very difference between the fore and hinder extremities shewing that man is intended for an upright posture. In this respect, he is altogether peculiar, as all the lower mammals inhabiting the dry land ordinarily go upon all-fours, although this is somewhat disguised in monkeys by their climbing powers. Monkeys belong to an order called *Quadrumana*,[5] the extremities of all the four limbs being fitted for use as hands, by having thumbs opposed in action to the fingers, and the hind-limbs having often the greatest grasping power.—Cuvier's order, *Carnaria*,[6] so designated because consisting of species which chiefly subsist by preying upon other animals, is divided into three sub-orders—*Cheiroptera*, *Insectivora*, and *Carnivora*. (1) *Cheiroptera*,[7] or Bats, are the only winged mammals. The wings of bats are very different in structure from those of birds, and consist chiefly of the bones of the fore-limbs, and particularly the finger-bones, prodigiously lengthened and united by membrane. Most of the bats feed chiefly on insects, although some large tropical species eat fruits.—(2) The *Insectivora*,[8] as moles, shrews, and hedgehogs, are mostly small timid creatures. They do not all prey exclusively on insects, although all have their molar teeth beset with small tubercles for breaking up the hard coverings of insect prey.—(3) The sub-order *Carnivora*[9] includes the quadrupeds which chiefly prey upon other vertebrate animals. Their muscular energy is very great, their respiration and circulation very active. Their use in the scheme of nature seems to be to prevent the undue multiplication of herbivorous animals, which, unless thus checked, would soon destroy the vegetation of the earth, and unfit it for their own abode. Cuvier divided the Carnivora into three sections. The first section, named *Plantigrade*,[10] contains those which place the whole sole of the foot on the ground in walking, of which the families of Bears and Badgers are the most notable. The second section, *Digitigrade*,[11] contains those which walk on the tips of the toes only, of

1 From Latin *unguis*, a nail.
2 From Latin *unguis*, a hoof.
3 Latin, 'mutilated.'
4 Latin, 'two-handed.'
5 Latin, 'four-handed.'
6 From Latin *caro*, *carnis*, flesh.
7 From Greek *cheir*, a hand, and *pteron*, a wing.
8 Latin, 'insect-eating.'
9 Latin, 'flesh-devouring.'
10 From Latin *planta*, the sole of the foot, and *gradior*, to walk.
11 From Latin *digitus*, a finger, and *gradior*, to walk.

which the chief families are the *Felidæ*,[1] including all the cat kind, the lion, tiger, leopard, lynx, &c.; the *Canidæ*,[2] of which dogs, foxes, and jackals are examples; *Hyænidæ*, to which the hyæna belongs; *Viverridæ*,[3] of which the civet is the best known example; and *Mustelidæ*,[4] the weasel tribe, including the ermine, marten, ferret, polecat, otter, &c. The most fierce and exclusively carnivorous quadrupeds belong to the orders Felidæ, Viverridæ, and Mustelidæ. The third section of the Carnivora in Cuvier's system is called *Amphibia*, and consists of seals, sea-elephants, the walrus, and similar animals, all marine, and having their feet adapted mainly for swimming, their teeth and digestive system for preying upon fish. The sea-elephant is more than twice the size of the largest African or Indian elephant.—The order *Marsupialia*[5] is distinguished by the *pouch* in which the females carry their young, the young being produced at an earlier stage than in other mammals. It is a curious fact that almost all the quadrupeds of Australia belong to this order, whereas elsewhere almost the only marsupial animals in the world are the opossums of America. Opossums and kangaroos are the kinds of which the names are most familiar to us, but there are many others, some of which are herbivorous and some carnivorous. The Marsupialia seem to be generally inferior to other mammals in intelligence.—The order *Rodentia*[6] consists of quadrupeds which have the front teeth—two in each jaw—large and of a peculiar structure, chisel-like, so as specially to adapt them for *gnawing*. Hares, rabbits, rats, mice, squirrels, and beavers are familiar examples of this order, the species of which are very numerous, and all of them small animals.—The order *Edentata*[7] is composed of animals, some of which are absolutely *destitute of teeth*, whilst others have small teeth only in the back part of their jaws. To this order belong sloths, armadillos, and ant-eaters, animals of very various habits, and differing in the nature of their food, yet exhibiting a general similarity of structure.

The *Ungulata* or hoofed quadrupeds are divided into two orders, *Pachydermata*[8] and *Ruminantia*.[9] The first of these orders contains elephants, tapirs, rhinoceroses, the hippopotamus, hogs, &c., all characterised by remarkable *thickness of skin*, and all feeding on vegetable food, although in other characters there is great diversity. To this order belong the largest of land animals. A section of the order very distinct from the rest, characterised by undivided hoofs, contains the horse tribe, the horse, ass, zebra, &c. The Ruminantia are the only animals in which the habit of *chewing the cud* is found. All of them are

1 From Latin *felis*, a cat.
2 From Latin *canis*, a dog.
3 From Latin *viverra*, a ferret.
4 From Latin *mustela*, a polecat.
5 From Latin *marsupium*, a pouch.
6 Latin, 'gnawers,' from *rodo*, to gnaw.
7 Latin, 'toothless,' from *e*, without, and *dens*, *dentis*, a tooth.
8 From Greek *pachys*, thick, and *derma*, skin.
9 Latin, 'chewing the cud,' from *rumino*, to chew again.

strictly herbivorous. To this order belong the families *Camelidæ*, containing the camel and dromedary of the old world, and the lama, alpaca, &c., of the new; *Camelopardidæ*, containing the camelopard or giraffe alone; *Cervidæ*,[1] containing the numerous species of deer; *Antilopidæ*, containing the numerous species of antelope; *Bovidæ*,[2] containing oxen, buffaloes, bisons, &c.; and *Capridæ*,[3] containing sheep and goats. It will be seen that many of the animals most useful to man belong to this important order.

The *Cetacea*[4] all inhabit the ocean, and have a fishlike form, but, unlike fishes, the tail is placed horizontally, so that they have great facility in diving and in ascending to the surface of the water, which they are under the necessity of doing very often, in order to breathe. They are as careful of their young as any land mammals. The largest whales sometimes attain a length of seventy or eighty feet, yet the food of these great animals consists entirely of molluscs and other small marine creatures, taken into the mouth along with floods of water, which soon afterwards escapes, the food having been sifted from it by the plates and fibres of *whalebone*, with which the great cavity of the mouth is filled. Other Cetacea, however, have no whalebone, but are furnished with teeth, and prey on fishes, of which we have an example in the porpoise of the British coasts. Two or three species of Cetacea differ entirely from the rest, in being herbivorous and having teeth like those of ordinary herbivorous quadrupeds. Such are the Dugong[5] of the Eastern Archipelago, and the Manatee or Lamantine of the West Indies. Their food consists partly of sea-weeds and partly of the luxuriant herbage on the banks of tropical estuaries, on which they browse when the tide enables them to reach it.

We have not attempted to point out the many and various uses of the Mammalia; nor have we been able, in almost a single instance, to allude to the beauty or peculiarity of their forms, to their habits, their intelligence, their affections, their capacity for domestication, and the like. It is a wide field which opens out before the student, who will everywhere see more and more to call forth his admiration of the Creator's wisdom and goodness.

[1] Latin *cervus*, a deer.
[2] From Latin *bos*, *bovis*, an ox.
[3] From Latin *capra*, a goat.
[4] From Latin *cete*, a whale.
[5] See bottom of page 106.

TABLE OF THE CLASSIFICATION OF ANIMALS.

**** *This table does not contain a complete classification of animals, but only the great Divisions and the principal Classes and Orders, as given in the preceding pages.*

DIVISION I.—PROTOZOA.

Animals of the most simple organisation, having no nervous system, and, with the exception of one group, no mouth or intestinal canal.

CLASSES.—Rhizopoda—Sponges—Infusoria.

DIVISION II.—CŒLENTERATA.

Animals with soft bodies composed of two layers, the digestive cavity being surrounded by tentacles.

DIVISION III.—RADIATA.

Radiated or Rayed animals, as star-fishes.

CLASS.—Echinodermata, as star-fishes, sea-urchins.

DIVISION IV.—ARTICULATA.

Articulated or Jointed animals.

CLASS I.—Annelidæ, as earthworms, leeches.
" II.—Myriopoda, as centipedes, gallyworms.
" III.—Crustacea, as the crab, lobster, shrimp.
" IV.—Arachnida, as the spider, scorpion, mite.
" V.—Insecta, insects.
ORDER 1. Coleoptera, insects having wing-cases, as the beetle, glow-worm, firefly.
" 2. Orthoptera, insects having soft wing-covers folded like a fan, as the locust, grasshopper, cricket.
" 3. Neuroptera, insects having four wings divided into a network, as the dragon-fly, may-fly, white ant.
" 4. Hymenoptera, insects having membranous wings, and many of them stings, as the ant, bee.
" 5. Lepidoptera, insects which have the wings covered with scales, and undergo a complete metamorphosis, as butterflies, moths.
" 6. Diptera, two-winged insects, as flies, midges, gnats.

DIVISION V.—MOLLUSCA.

Soft-bodied animals, as snails, whelks, limpets, oysters, mussels, cuttle-fish, squids.

DIVISION VI.—VERTEBRATA.

Animals having an internal skeleton with backbone and skull.

CLASS I.—Fishes, cold-blooded animals, as the herring, cod, salmon, shark.
SUB-CLASS 1. Osseous Fishes, as the cod, salmon, herring.
" 2. Cartilaginous Fishes, as the shark, skate, sturgeon.
" II.—Amphibians, cold-blooded animals, living either on land or in water, as the frog, toad, newt; and breathing by gills when young, and by lungs when mature.
" III.—Reptiles, cold-blooded animals, breathing by lungs at all periods of life.
ORDER 1. Ophidians or Serpents.
" 2. Saurians, as lizards, crocodiles.
" 3. Chelonians, as tortoises, turtles.
" IV.—Birds, warm-blooded animals, oviparous, and covered with feathers, the fore-limbs being modified into wings.
ORDER 1. Accipitres, Rapaces, or Raptores, birds of prey.
GROUP 1. Diurnal, as eagles, falcons, hawks, vultures.
" 2. Nocturnal, as owls.

CLASS IV.—*continued.*

ORDER 2. **Insessores**, with feet adapted only for perching, as crows, thrushes, linnets, larks, and sparrows.

" 3. **Scansores**, having feet specially adapted for climbing, as parrots, cuckoos, and woodpeckers.

" 4. **Rasores** or **Gallinaceous Birds**, having short stout claws, adapted for scraping the earth in quest of food, as the common fowl, turkey, peacock, pheasant, partridge, &c.

" 5. **Cursores**, large birds with long legs and very short wings, incapable of flight, as the ostrich, cassowary, and emu.

" 6. **Grallæ** or **Grallatores**, long-legged birds, with feet adapted for wading, or for walking on sand or mud, as herons, cranes, storks, snipes, and woodcocks.

" 7. **Natatores**, aquatic birds with webbed feet, as swans, geese, ducks, gulls, and penguins.

" V.—**Mammalia** or **Mammals**, warm-blooded animals, viviparous, and suckling their young.

SECT. 1. **UNGUICULATA**, having nails or claws.

ORDER 1. **Bimana**, having the fore-limbs terminated by hands, the hinder limbs by feet. Man is the only species.

" 2. **Quadrumana**, having all the four limbs terminated by hands, and capable of grasping, as monkeys.

" 3. **Carnaria**, mammals which subsist chiefly by preying on other animals.

SUB-ORDER 1. **Cheiroptera**, winged mammals, all generally known by the name of bats.

" 2. **Insectivora**, small quadrupeds having teeth adapted specially for insect prey, as shrews, moles, and hedgehogs.

" 3. **Carnivora**, quadrupeds chiefly preying on other vertebrate animals.

SECT. 1. **Plantigrade**, walking on the whole sole of the foot, as bears.

" 2. **Digitigrade**, walking on the toes only, as the cat, lion, tiger, &c.—dog, fox, civet, weasel.

" 3. **Amphibia**, marine animals, having feet adapted mainly for swimming, as seals, the walrus, and the sea-elephant.

" 4. **Marsupialia**, distinguished by the pouch in which the females carry their young, as kangaroos and opossums.

" 5. **Rodentia**, having the front teeth specially adapted for gnawing, as hares, rabbits, rats, mice, squirrels, and the beaver.

" 6. **Edentata**, having no teeth, or only small teeth in the back part of the jaws, as sloths, ant-eaters.

SECT. 2. **UNGULATA**, having hoofs.

ORDER 1. **Pachydermata**, having a thick skin, and feeding on vegetable food, as elephants, rhinoceroses, the hippopotamus, hogs, the horse, ass, and zebra.

" 2. **Ruminantia**, herbivorous animals, chewing the cud, as the camel, giraffe, deer, ox, buffalo, &c.—sheep, goat.

SECT. 3. **MUTILATA**, having no hind-limbs, and the fore-limbs modified into fins.

ORDER, **Cetacea**, as whales and porpoises.

CLASSIFICATION OF ANIMALS.

The student ought to make himself thoroughly familiar with the primary DIVISIONS of the animal kingdom and their distinctive characters. They are sometimes called SUB-KINGDOMS, and some of them are divided into *sections*, as Fishes into *Osseous* and *Cartilaginous*. They are all divided into *classes*, and these again into *orders*; which are further divided into *families*, and these into *genera*. A genus sometimes contains only one species, when it differs so much from all others as to require such a separate place; but some genera contain a great number of species, nearly resembling each other. A *species* consists of those individuals which are derived, or may be supposed to be derived, from a common parentage. A species is designated by the name of its genus with another word added—sometimes a name derived from the country which it inhabits, or from the name of its discoverer, often a Latin adjective, and sometimes indicative of some of its most marked characters. Thus the robin redbreast is *Sylvia rubecola*; *Sylvia* being a genus that includes many similar birds, and belonging to a family called *Sylviadæ*, which contains many genera, all of small birds, such as those known by the name of warblers, and amongst which are our finest song-birds. The relations of the terms *Division*, *Class*, *Order*, *Family*, *Genus*, and *Species* ought to be carefully observed and remembered.

We give the following as specimens of the classification of animals, selecting well-known species:

THE OX.

Species.....*Bos taurus.*
Genus.....*Bos.*
Family.....*Bovidæ.*
Order.....*Ruminantia.*
Class.....*Mammalia.*
Division.....*Vertebrata.*

THE ROBIN REDBREAST.

Species.....*Sylvia rubecola.*
Genus.....*Sylvia.*
Family.....*Sylviadæ.*
Order.....*Insessores.*
Class.....*Aves* (Birds).
Division.....*Vertebrata.*

THE COMMON LAND-TORTOISE.

Species.....*Testudo Græca.*
Genus.....*Testudo.*
Family.....*Testudinidæ.*
Order.....*Chelonia.*
Class.....*Reptilia* (Reptiles).
Division.....*Vertebrata.*

THE COMMON FROG.

Species.....*Rana temporaria.*
Genus.....*Rana.*
Family.....*Ranidæ.*
Order.....*Batrachia.*
Class.....*Amphibia.*
Division.....*Vertebrata.*

THE COMMON TROUT.

Species.....*Salmo fario.*
Genus.....*Salmo.*
Family.....*Salmonidæ.*
Order.....*Malacopterygii.*
Class.....*Pisces* (Fishes).
Division.....*Vertebrata.*

THE GARDEN SNAIL.

Species.....*Helix nemoralis.*
Genus.....*Helix.*
Family.....*Helicidæ.*
Order.....*Pulmonata.*
Class.....*Acephala.*
Division.....*Mollusca.*

THE LOBSTER.

Species.....*Homarus vulgaris.*
Genus.....*Homarus.*
Family.....*Astacidæ.*
Order.....*Decapoda.*
Class.....*Crustacea.*
Division.....*Articulata.*

THE COMMON STAR-FISH, CROSS-FISH, OR FIVE FINGERS.

Species.....*Uraster rubens.*
Genus.....*Uraster.*
Family.....*Asteriadæ.*
Order.....*Asteroidea.*
Class.....*Echinodermata.*
Division.....*Radiata.*

Dugong.

BOTANY.

BOTANY, from the Greek *botanē*, an herb, is the science which treats of *plants* or the Vegetable Kingdom. That part of the science which relates to the processes of plant-life is called VEGETABLE PHYSIOLOGY.

The life of a plant is very different from that of an animal. Plants and animals, however, agree in having a limited term of existence—they are born, being produced from seed; they grow, become old, and die, having during their life produced others of their own kind to replace them.

Organs—Cells.—Plants and animals agree also in being entirely composed of *organs*. These organs are made up of other organs, and every plant or animal ultimately consists of *cells*, which are at first little globules, but often become extended into very various forms. The cells of a plant have at first a thin skin like a little bladder, containing a fluid substance, in which a kind of motion is kept up. Everything in plants and animals is formed from these cells, even the wood of plants and the bones of animals. A plant or an animal grows by adding cell to cell, changes also taking place in the cells already formed. One cell is added to another, or grows from another in a determinate manner, according to the nature of each particular kind of plant or animal, and of each particular part of it.

Earliest Stages of Plant-life—Germination of Seed.—A plant in the earliest stage of its existence, as it is formed in the parent plant, consists of a single cell, which is gradually developed into a *seed*. As the seed is matured, in all the higher kinds of plants, such as trees and flowering-plants, many cells are formed in it. In a flower, we find the rudiment of the *seed-vessel*, containing the rudiments of the seeds, which are called *ovules*,[1] from their resemblance to *little eggs*.—The rudimentary seed-vessel itself is called the *ovary* or *germen;* the term *ovary* signifying that it contains the little eggs or ovules, and *germen*, a Latin word, indicating its purpose as that part of the plant from which new plants are

[1] Latin *ovula*, a little egg.

to proceed. When the seed is placed in the ground, in favourable conditions of heat and moisture, it soon begins to *germinate*[1] or sprout. Changes take place within the seed itself, new cells are formed, and through a hole in the covering of the seed, not in general easily perceptible before, a little root is sent out, which descends into the soil to seek nourishment; whilst from the same part of the seed a shoot ascends into the air, and begins to develop leaves, by which also the plant seeks nourishment; for it is sustained not only from the soil through its roots, but from the air through its leaves, the leaves being organs of nutrition as much as the roots, and equally essential to life. The part of the seed which extends downward into the soil and forms the root, is called the *radicle*[2] or little root (*c*, fig. 72); the ascending part, which becomes the stem, and from which leaves, flowers, and fruit are developed, is called the *plumule*[3] or little feather (*b*, fig. 72), many plants, when they first spring from the ground, having somewhat the appearance which this term suggests.

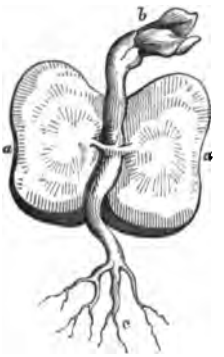


Fig. 72.—A bean beginning to grow, spread open.

Growth and Structure of Plants.—As plants grow, the stem of many divides and subdivides into branches, but there are others in which no such division takes place, and there are many, as primroses, lilies, and hyacinths, which send up no stem, but have only flower-stalks, such as spring from the buds of other plants, arising from the *crown of the root*. There are also plants which have neither stem nor leaves, nor even roots, but which imbibe their nourishment through their whole surface from the air or water in which they live, as lichens, fungi, and sea-weeds. In the very lowest and simplest forms of vegetation, nothing is to be found but a mere cell, or a number of cells variously grouped together, each cell, however, appearing to be an independent plant.

Cellular Tissue and Vascular Tissue.—Some portions of all plants, and the whole of some, consist of what is called *cellular tissue*—that is, of mere cells variously aggregated. Cellular tissue abounds in the soft and fleshy parts of plants; and some of these are often greatly developed and increased by cultivation, so as to render the plant more useful to man. The parts of plants used for food consist mainly of cellular tissue. Cells, however, often extend in particular directions as the plant grows, or numerous cells are combined into one, some part of the separating

[1] Latin *germinare*, to sprout.
[2] From Latin *radix*, *radicis*, a root.
[3] From Latin *pluma*, a feather.

membranes or *cell-walls* being absorbed; and at the same time the membrane which encloses the united cells thickens, by deposits taking place in its interior. Thus *vessels* are formed, which are closed tubes tapering to both extremities, and a substance called *vascular tissue*,[1] which is less soft and succulent than cellular tissue, and often becomes very tough and hard. Vascular tissue is generally found wherever strength is required, as in stems, the ribs of leaves, and the shells of nuts. A most important kind of vascular tissue is *woody tissue*, which in shrubs and trees becomes compacted into *wood*, the vessels being filled up by the deposits which take place in them, so that great solidity is attained. Not only is the wood of many trees of great value to man, but woody tissue, which never becomes compacted into wood, is also of much importance, as affording the fibrous materials of which cordage and clothing are made. Another kind of vascular tissue consists of *spiral vessels*, which are tubes of extreme fineness, sometimes not more than one three-thousandth part of an inch in diameter, coiled up within the young shoots and leaf-stalks of plants. These spiral vessels may be pulled out to a great length. If a young shoot or leaf-stalk of a geranium be broken, and the parts gently pulled asunder, the spiral vessels will be seen, delicate as the threads of a cobweb. Their great number, however, and their closely compacted coils, add to the strength of the shoot or leaf-stalk, whilst they contribute also to the circulation of its sap.

Organs.—The organs of which plants consist are divided into two classes —*Nutritive Organs* and *Reproductive Organs;* the former being those which are essential to the life of the individual plant, the latter those which have for their purpose the perpetuation of the race. The nutritive organs are the root, stem, and leaves; the reproductive organs are the flowers and all organs concerned in the production of seeds.

Nutritive Organs of Plants.

The Root.—The *root* not only serves the purpose of drawing nourishment from the soil, but also that of fixing the plant in its place, and it has often been remarked with admiration that trees growing in exposed situations send out more numerous roots than those which grow in sheltered places, as if to anchor themselves more firmly, and to secure themselves against storms.

Roots are often branched, and the branching is repeated again and again, particularly in hard and woody roots, which are divided at last into fine fibres. Softer roots are often quite unbranched, as in the hyacinth. The extremities of roots consist of loose cells, forming a minute spongy

[1] From Latin *vasculum*, a little vessel.

mass called a *spongiole* or little sponge, and by these cells the fluid nourishment of the plant is imbibed. Animal and vegetable membranes have the property of allowing fluids to pass through them, not by any special pores, but at all parts, through minute interstices in their whole structure; and when the membrane is very thin, as that is which forms the cells of a spongiole, and the fluid on one side of it differs considerably in density from that on the other, an exchange pretty rapidly takes place by what is called *osmotic action*.[1] This may be exemplified by filling a bladder with brine from salted meat, and placing it in a vessel full of pure water, when much of the salt of the brine will soon be found to pass through the bladder into the water by which it is surrounded. The animal substances contained in the brine will, however, remain in the bladder, which will receive a quantity of water greater than that of the substances which have passed out. Osmotic action is carried on to a great extent in nature, the cells both of animals and plants thus imparting their contents to those which are in contact with them, so that a motion of fluids is kept up even where there are no proper veins or tubes, and changes are at the same time effected in the fluids themselves. And thus it is that the roots of plants take in nutriment, whilst they are also continually giving forth substances which the plant may be said to desire to be quit of, and the continual growth of the root pushes forward the spongiole into a new place, where it finds fresh soil. The soil in which a plant grows therefore undergoes a twofold change, being deprived of the substances most beneficial for the nourishment of the plant, and more or less filled with others which are specially unsuitable to it; but these are often very suitable for other plants; and thus the farmer finds a rotation of crops more advantageous than a continual repetition of the same kind of crop on the same land.

Roots are covered with a bark like that of stems; and the roots of some plants, if by accident or design exposed to the air, produce buds from which shoots or branches proceed. The roots of many plants extend underground and send up shoots. Many plants also send forth roots from the stem or branches, when these are brought into contact with the soil, or partially buried in it; and advantage is taken of this to propagate some kinds of trees and shrubs by *cuttings*, which soon produce roots when planted in moist earth, or by *layers*, which are branches bent down and partially covered with earth, but not separated from the parent plant till the new roots are formed. Some plants, in their ordinary growth, send forth roots from the stem or branches, which, as they elongate, seek the ground, and form new stems or props to the stem, adding also to the supply of nourishment from the soil. A remarkable

[1] From Greek *osmos*, impulsion.

example of this is seen in the banyan-tree of India, from the wide-spreading branches of which roots descend straight to the ground, so that a vast canopy of branches and leaves is formed, supported by numerous

Fig. 73.—The Banyan-tree.

tall columns. A banyan-tree has been described having no fewer than 350 stems equal to large oaks, and more than 3000 smaller ones, covering a space sufficient to contain 7000 persons.

Tubers and Bulbs.—Some soft roots swell very much in favourable circumstances, storing up in their cells nourishment for the future wants of the plant. The swelling takes place in various forms. The turnip and the carrot afford instances of two of the most common forms. The *tubers*[1] of the potato are not properly parts of the root, but short and thick subterranean stems, the *eyes* being buds ready to send up shoots into the air in the spring of the following year, and the substance of the tuber being a provision for the nourishment of these shoots, until they become independent of the parent plant. *Bulbs* also, as those of the onion, the lily, and the hyacinth, are not really parts of the root, although we familiarly speak of such plants as *bulbous-rooted*, and of the potato and the Jerusalem artichoke as *tuberous-rooted*. A bulb is, in fact, a subterranean bud, and the true stem is the very short hard part at its base from which the roots spring.

Stems.—Some plants have their stems entirely underground; not only those which have extremely short stems, and are commonly described as *stemless*, but some also in which the stem extends to a considerable length. A root-like stem, creeping underground, or along the surface of the

[1] Latin, 'a swelling,' from *tumeo*, to swell.

ground, sending down roots into the soil, and sending up shoots into the air, is called a *root-stock*. Examples may be seen in the yellow iris and in Solomon's seal. Whilst some plants have strong and erect stems, capable of sustaining all the weight of their branches and leaves, the stems of others are slender and weak, trailing along the ground, or depending upon other plants for their support. Of those which seek the support of other plants, some are provided with tendrils, by which they lay hold of them, and others twine around them. The pea is an instance of a *climbing plant*, and its tendrils coil in an admirable manner around the branches to which it clings. The scarlet runner is a twining plant: it has no tendrils, but its long stem twines round any pole or branch with which it meets. It is remarkable that twining stems always twine in a particular direction, some from right to left, others from left to right. The scarlet runner twines from right to left, the hop and the honeysuckle twine from left to right. Climbing and twining plants greatly abound in tropical countries, and contribute much to the prodigious density of vegetation in the forests, some of them ascending to the tops of the most lofty trees, and falling down again from their high branches, rich in foliage, and often also in flowers of the greatest beauty, or binding tree to tree, so that the forest becomes impenetrable.

Soft stems are called *herbaceous*, and the plants to which they belong are called *herbaceous plants*, in contradistinction to trees and shrubs, which are *woody plants*. Herbaceous stems are often annual—that is, their existence is limited to a single year. They rise from the ground in spring, and die on the approach of winter, even although the root may survive. Woody stems subsist during the whole life of the plant.

Buds and Branches.—Stems, as they grow, produce buds. The stem always terminates in a bud; and in some plants, as in the greater number of palms, this is the only bud. In this case, there are no branches, what are often spoken of as the branches of palms being really leaves of extraordinary magnitude. Branches proceed from lateral buds. The buds of some plants arise only from certain well-marked points of the stem, called *nodes*[1] or knots, which appear as joints, of which a strongly marked example is found in the bamboo; and although this cannot be so clearly observed in other plants, yet in all a certain rule is followed, so that the buds do not appear irregularly scattered, but arranged according to a definite method. Thus the arrangement of leaves is different in different plants; in one they are in pairs on opposite sides of the stem, in another they spring from opposite sides alternately, while in some they are found in whorls. They are very generally arranged in a kind of spiral manner around the stem. A similar diversity of arrangement

[1] Greek *nodos*, a knot.

appears in the branches, which spring from the *axils*[1] of leaves, every plant having its own peculiar and characteristic mode of branching, which, by giving diversity of aspect to trees, greatly contributes to the beauty of nature. Buds remain dormant during winter, the tender parts being protected from the frost by the scales with which they are covered. In spring, they begin to grow, when the sap ascends in the tree. Many buds, however, remain always dormant, especially on the lower parts of the stem and branches, the strength of the plant being directed to the production of branches and leaves in its upper and outer parts; but if a branch is cut off over above a bud which it has thus seemed to neglect, the bud at once begins to grow, and to send forth a shoot in place of that which has been removed. Some plants send forth branches of peculiar kinds. The *runner* of a strawberry is a kind of branch, although the plant is one of those in which the stem is scarcely developed. Such a branch, producing a bud at its extremity, serves for the extension of the plant over the surface of the ground, the bud soon sending down roots, and becoming capable of independent existence.

Structure of Stems.—There are great differences in the structure of stems, and, according to these, plants are arranged into different classes, which differ also very much in other important characters. Three modes of structure are distinguished, and stems are accordingly described as *exogenous*, *endogenous*, or *acrogenous*, terms which are also applied to the plants to which they belong.[2]

Exogenous Stems.—Exogenous stems are those which have a *bark* distinct and separable from the wood, and in the centre of the stem a *pith*, which sends out branches, called *medullary rays*,[3] through all parts even of the hardest wood. The medullary rays keep up a connection between the pith and the soft growing part immediately under the bark, and are essential to the nourishment of the wood. Exogenous stems increase in thickness by new layers of *vessels* formed under the bark, which gradually harden into wood; and the layers produced year after year are very often so distinctly marked, that the age of a tree may be pretty accurately computed by counting the number of them exhibited in a transverse section of its stem. All the trees and shrubs to be seen in Britain, and very

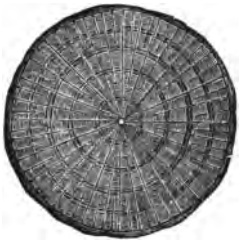


Fig. 74.—Transverse Section of Exogenous Stem.

[1] The hollows where the branches unite with the stem, from Latin *axilla*, the armpit.

[2] These terms are derived from the Greek words *gennaō*, to produce, *exō*, outwards, *endon*, inwards, and *akros*, highest; and they are employed as indicating the manner in which these different kinds of stems grow.

[3] From Latin *medulla*, pith.

many of the herbaceous plants, are exogenous. In herbaceous stems, the medullary rays are generally large, and the more solid part of the stem consists of *vascular bundles*, arranged around the pith, and these bundles, when cut across, appear somewhat wedge-shaped, becoming broader outwards. The arrangement is beautifully regular. In trees and shrubs, the medullary rays generally become very fine as the wood hardens, so that they do not much affect its solidity.

The *pith* consists of cellular tissue.—The *wood* consists of vascular tissue, and chiefly of long vessels, closed at the ends, which, as they become old, are gradually filled up with solid matter. The wood nearest the pith is harder than the younger wood near the bark, and in some trees is also very different in colour. The matured wood is called *heart-wood* or *duramen*;[1] and the soft wood, which forms the outer part of the stem, is called *sap-wood* or *alburnum*.[2]—Next to the wood, on the outside, is a layer of soft cells, called the *cambium layer*, formed in a mucilaginous fluid, called *cambium*,[3] which may be best observed in young shoots, and in spring when vegetation is most active. From the cambium layer, the new layer of wood is formed, and the necessary increase is also made to the bark.—The bark, in young stems or branches, consists of mere cellular tissue, but vessels are afterwards formed in the inner portion of it, which often become long and strong fibres. The valuable fibres of flax and hemp belong to the inner bark of these plants; and bast mats are made of the inner bark of the linden or lime tree. There is an Indian tree of the bark of which sacks are made by merely stripping the bark from the wood, which is done by beating it till it comes off readily, as boys make 'plane-tree' whistles. The *inner bark* is also called the *bast*. Its Latin name is *liber*, which is also the Latin for 'a book,' this bark having been used for writing on before the use of paper or parchment was known. The outer part of the bark is entirely cellular, but consists of two layers, easily to be distinguished. The outermost of these is that which, in the cork-tree, increases to a great thickness, affording us the substance known as cork. The bark itself is surrounded by an integument, called the *epidermis*, the use of which seems merely to be the protection of the whole: in old stems it is thrown off, although it is always to be found in young and tender shoots.

Endogenous Stems.—Endogenous stems have no pith and no bark. The outer part of the stem may indeed be somewhat different from the rest, and have the appearance of a bark, but it cannot be separated from the wood like the bark of an exogenous tree. As an endogenous plant grows, the stem increases in thickness, not by the addition of layers on the

1 From Latin *durus*, hard.
2 From Latin *albus*, white.
3 Low Latin, 'nutriment,' from Latin *cambio*, to change.

outside, but by the formation of new bundles of vessels in the centre, which push out those previously formed, as long as they are soft enough; but when they are thoroughly hardened, this no longer takes place, and the stem increases in length without further increase of thickness. Thus palms are, in general, of almost uniform thickness from the root to the crown of leaves, and the outer part of the stem is often very hard, whilst the central part is soft and spongy, and amongst its cells there is often a great deposit of starch, which, in the sago palms, is so abundant as to be of economical importance. Palms are almost the only endogenous *trees*, and no endogenous tree is found anywhere but in the warmer parts of the globe. Endogenous plants, however, abound in all countries, and amongst them are all the grasses and all the plants which have bulbs. Endogenous stems are very often unbranched, producing no buds but the terminal bud. The great terminal bud of a palm resembles a cabbage in size, and also in quality, so that palms are often cut down for the sake of it. It is called the *palm cabbage;* and some kinds of palm, in which it is particularly good for the table, receive the name of cabbage palms. The rapid growth of many endogenous stems ruptures the central cells, and thus a hollow stem is produced, as in grasses.

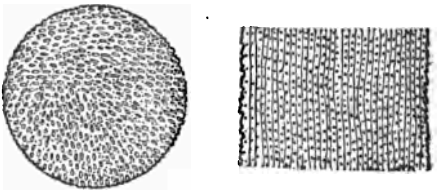


Fig. 75.—Transverse and Vertical Sections of Endogenous Stem.

Acrogenous Stems.—Acrogenous stems resemble endogenous stems in having neither pith nor separable bark, but differ from them in their mode of growth, all the bundles of vessels, or fibres, being developed at once, so that the stem increases only by additions at the summit. The acrogenous stem has no branches, but produces a crown of leaves; so that a tree-fern, which is the only kind of acrogenous *tree*, has a general resemblance to a palm. In the ferns of Britain and other temperate countries, the stem creeps along the ground as a root-stock.

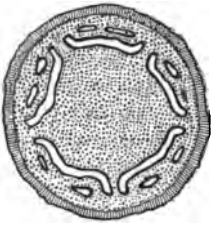


Fig. 76.—Transverse Section of Acrogenous Stem.

Fig. 77. Tree-fern.

Leaves.—Leaves are most important organs of plants. They expose a great surface to the air, imbibe what the plant requires for its nourishment, and give out what is no longer useful to it. They are of very great importance in the system of nature, the gases which the leaves give out being generally those most needful for the support of animal life, so that the multitude of leaves on the face of the earth keeps the air fit for the use of animals, whereas it would otherwise become such that animals could no longer breathe it and live.

Leaves are curiously folded or rolled up in the bud before they are developed. In some plants, they are folded by the midrib, the two halves of the leaf lying together; in others, they are folded in a fan-like manner; in some, they have their edges rolled inwards, in others, outwards; and in some, they are rolled together in a single coil. The different modes in which the leaf is formed in the bud are characteristic of different plants. The cherry and the plum are trees nearly allied, but the leaves of the cherry are folded together in the bud, while those of the plum are rolled up.

The expanded part of a leaf generally faces the sun, the influence of light being necessary as well as that of air. This expanded part is called the *blade of the leaf*. The leaf, however, is often supported by a stalk, called the *leaf-stalk* or *petiole*,[1] which in trees and shrubs is often woody, and in some, particularly in palms, becomes thick and hard like a branch. Leaves which have no leaf-stalk are called *sessile*,[2] because they seem to *sit* upon the stem or branch. In many plants, the leaves which spring from the crown of the root differ very much from those which are produced higher on the stem. Thus, the common harebell has root-leaves nearly round, whilst those of its stem are very narrow. The leaf-stalk divides into branches, which form the *ribs* or *veins* of the leaf, and give it the necessary strength. In endogenous plants, the veins of the leaf are in general nearly parallel, running unbranched throughout the whole length of the leaf, as may be seen in grasses; in exogenous plants they break into branches, which spread in various directions, and are again and again branched, so as to form a kind of network, as may be seen in the leaf of the elm or the primrose. This difference in the leaves characterises these two classes of plants as much as that in the structure of the stem. The leaves of acrogenous plants have generally forked veins.

In some plants, the leaf-stalk is broad, and the blade of the leaf at its extremity is very small, or scarcely exists, as in many species of *Acacia*. In this case the leaf-stalk serves the purposes which are ordinarily served

1 'The little foot,' from Latin *pes*, *pedis*, the foot.
2 From Latin *sessilis*, sitting, from *sedeo*, *sessum*, to sit.

by the blade of the leaf. Some leaves are thick and fleshy. The forms of leaves are very various, and many are divided into lobes or segments. A leaf much divided into lobes may yet consist altogether of one piece; and a leaf which consists of one piece, whether lobed or not, is called a *simple* leaf. Many leaves, however, are *compound*—that is, they are made of a number of pieces, the leaf-stalk branching by joints, and sometimes branching again and again, each branch or branchlet bearing a separate blade, called a *leaflet*. Such leaves are called *pinnated*,[1] when the leaflets are arranged on opposite sides of the stalk, as in the ash or the laburnum. A leaf may be *bipinnate*—that is, twice pinnate—or the leaf-stalk may be still more subdivided. In some compound leaves, the leaf-stalk divides into three branches, as in the clover or trefoil; in others it sends off a number of leaflets in a radiating manner from its extremity, as in the horse-chestnut.

Stomata.—In the epidermis of leaves there are minute openings, called *stomata*, a Greek word signifying *mouths*. These are also found in the epidermis of young shoots, and of other green parts of plants. They serve for the admission of air as the plant requires it, and for the exhalation of what it gives off into the air; and leaves have therefore sometimes been called the *lungs* of plants. The stomata are very small, and can only be discerned by the aid of a microscope. There are sometimes 160,000 or more in a square inch of surface; and in those plants which have fewest and largest stomata, there are about 200 in a square inch.

Circulation of Sap.—Plants have no organ resembling the heart of an animal, and the circulation of sap which takes place in them is of a very different nature from the circulation of blood. The sap imbibed by the roots ascends through the vessels of the stem, and passes from vessel to vessel by osmotic action. In plants wholly formed of cellular tissue, the sap seems to proceed in any direction from one cell to another, till the whole substance of the plant is permeated; in vascular plants, particular parts of the plant appear to be chiefly concerned in this process, which, however, is very imperfectly understood. It is known that the sap circulates most abundantly through the youngest layers of wood, whilst in the old and thoroughly hardened layers it almost entirely ceases, and these may therefore almost be regarded as having ceased to live, and as useful to the plant only by giving strength to its stem. The sap reaches every part of the plant, being conveyed through the finest leaf-stalks and flower-stalks, and penetrating the most delicate parts of the flowers. In the leaves and other green parts, it is modified by the action of the air and light, and afterwards descends again to the root, which it is generally believed to do through vessels in the bark, giving off supplies of nourishment

[1] From Latin *pinna*, a wing.

to every part of the plant as it descends; for the nourishment of the organs of a plant is supposed to be derived more from the sap that has been elaborated in the leaves than from the ascending sap in its original state. The rise of the sap in spring is one of the unexplained wonders of nature; it cannot be ascribed to the mere increase of heat, for it begins in many plants during the very coldest weather of winter. They have had their period of rest, and their time of activity comes again. Plants need rest as well as animals. A plant continually forced to grow, by artificial application of heat and moisture, soon ceases to live; and gardeners well know the necessity of allowing rest to hothouse plants. The plants of tropical countries often have their periods of rest and activity determined by the wet and dry seasons, which are to them as summer and winter.

Reproductive Organs of Plants.

The reproductive organs of plants are very different in the lower and the higher kinds. Of some of the lowest kinds we know nothing more than that they increase by the addition of one cell to another, and are propagated by the separation and diffusion of these cells; although it is probable that even these plants produce seeds or spores, by which they are multiplied. Their very minute size, however, makes it difficult to investigate the processes of their life. In the highest kinds of plants, the reproductive organs are the *flowers*, and the fruit produced by them.

Flowers—Inflorescence.—The arrangement of the flowers upon a stem or branch is called the *inflorescence*[1] of a plant. In some plants, each flower arises from the root on a separate stalk; in others, it arises in like manner from the stem or from a branch. In some, many flowers are produced on a single stalk, and the upper part of a stem or branch often becomes itself a flower-stalk, its leaves becoming modified into *bracts*,[2] which are placed under each flower or each division of the flower-stalk. Bracts sometimes resemble the ordinary leaves of the plant, but are very often much smaller and less divided, and are sometimes membraneous and dry, sometimes of colours very different from the leaves. In some plants, the bracts are large, and in the bud enclose a stalk which produces numerous flowers. The bract in this case is called a *spathe*,[3] and the flower-stalk a *spadix*.[3] An example is seen in the wake-robin, and palms have this form of inflorescence. In some palms, the spathe is very large, thick, and leathery, so that it is often made into a sack or bag; and there are palms which have a spadix twenty feet long, and bearing more than 200,000 flowers.

[1] From Latin *in*, upon, and *floresco*, to flower.
[2] From Latin *bractea*, a thin plate of metal, gold-leaf.
[3] From Latin *spatha*, a broad leaf.

When flowers grow from an elongated flower-stalk without distinct stalks of their own, or when their separate stalks are very short, they form a *spike*, as in the plantain or rib-grass; when the separate stalks are of notable length, we have a *raceme*,[1] as in the hyacinth. Both spikes and racemes are often compound by the branching of the principal stalk. Compound spikes sometimes have their branches or *spikelets*, closely compacted into a *head of flowers*. Spikes of a close form, having a scaly bract under each flower, are called *catkins*.[2] When the lower flowers of a raceme are supported on longer stalks than the upper, so that all the flowers are nearly on a level at top, as in the hawthorn, we have a *corymb*.[3] When all the branches of a raceme spring from nearly the same point, and diverge in a radiating manner, they form an *umbel*.[4] An example of the umbel may be seen in the cowslip, but this form of inflorescence is particularly characteristic of a great order of plants, therefore called *Umbelliferæ* or umbel-bearers, of which the carrot, the cow-parsnip, and the hemlock are familiar examples. In all these forms of inflorescence, the first flowers which expand are the lowest or outermost. There are plants, however, in which the first flowers produced are the most central. In this case, the flowers are often produced on stalks which grow up together in nearly equal length, and form what is called a *cyme*,[5] an example of which may be seen in the elder.

Flowers—Parts of the Flower.—Flowers are produced from buds as leaves are. The parts of a flower are, in fact, leaves changed as to their form and use, but produced and arranged after the manner of leaves; and their true nature is shewn by their sometimes becoming leaves again in what are called *monstrosities* of plants, which often occur when a plant receives excess of nourishment through cultivation. They arise from the stalk of the flower, as leaves arise from the stem, but form definite groups very distinct in character and use. These groups are generally whorls, even when the leaves of the plant are not whorled. The first or outermost whorl (*g*, fig. 78) forms the *calyx* [Greek, a cup], and commonly consists of small green leaves called *sepals*, which are often united so as to form a kind of cup. The use of the calyx seems to be the protection of the more tender parts of the flower, and it encloses them all when in bud. The second whorl of leaves, which may either be quite distinct, or may unite into a cup, bell, or tube, is the *corolla*[6] (*h*, fig. 78), generally the most beautiful part of the flower; the leaves which form it, called *petals*,[7] being delicate and finely coloured. The calyx, however, sometimes assumes an appearance similar to that of the corolla; and in some plants, these whorls grow so closely

1 From Latin *racemus*, a cluster of grapes.
2 From the resemblance of a cluster to a cat's tail.
3 From Latin *corymbus*, a cluster of fruit.
4 'A little shade,' from Latin *umbra*, a shade.
5 From Latin *cyma*, a sprout.
6 Latin, 'little crown,' diminutive of *corona*, a crown.
7 Latin *petalum*, a leaf.

together as to be almost one, and resemble one another very closely, as in the crocus. In this case, they are not generally distinguished by the names of calyx and corolla, but receive together the name of *perianth*,[1] because they surround the essential parts of the flower. These parts are the *stamens*[2] and *pistils*.[3] From an analogy with animals, the stamens are called the male organs, and the pistils the female organs of fructification.

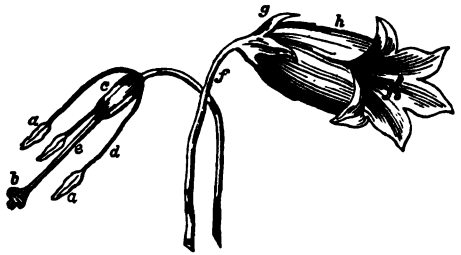


Fig. 78.—Flower of Campanula: *a*, anther; *b*, stigma; *c*, germen; *d*, filament; *e*, style; *f*, flower-stalk; *g*, calyx; *h*, corolla.

The stamens form the whorl next within the corolla; the pistils are the innermost of all, and are the final extension of the stem or stalk from which the flower grows. The pistils contain the ovules, which, when matured, become the seeds. A pistil is sometimes formed of one modified leaf, and sometimes of several, more or less united. Each leaf which enters into the formation of the pistil is called a *carpel*,[4] and each carpel has its own ovules. The lower part of the pistil is the *germen* or *ovary* (*c*, fig. 78), in which are the ovules; from this rises the *style*[5] (*e*, fig. 78), which is crowned by the *stigma*[6] (*b*, fig. 78). The style is often very slender, although in some flowers it is thick and stout. The stigma also assumes very various forms; it is sometimes broad and large, sometimes nothing more than the mere point of the style. The style is sometimes altogether absent, and the stigma rests immediately on the summit of the germen. The only use of the style is as a tube to communicate between the stigma and the germen. The stamens are ranged around the pistil. In some plants, they are few in number; in others, they are very numerous. Those plants which have few stamens have a certain number of them, as they have also a certain number of sepals and of petals; and it very often happens that there is a correspondence in these numbers, so that some plants are *dimerous*, some *trimerous*, some *tetramerous*, and others *pentamerous*.[7] The crocus is an example of a trimerous flower; the primrose is a pentamerous flower. A stamen consists of two

1 From the Greek *peri*, around, and *anthos*, a flower.
2 Latin *stamen*, a thread, a fibre.
3 So called from their likeness to the *pestle* of a mortar.
4 From Greek *karpos*, a fruit.
5 From the Greek *stylos*, a pillar.
6 Greek, 'a mark.'
7 From the Greek *meros*, a part, *dis*, twice, *tres*, three, *tetra*, four, and *penta*, five.

parts, called the *filament*[1] (*d*, fig. 78), and the *anther*[2] (*a*, *a*, fig. 78). The filament is the modified stalk of the leaf, the anther its blade. The filament is generally slender, as the name indicates; in some flowers it is extremely so, but in others it is thick and stout, and in some it is altogether absent; whilst the anthers are sometimes produced on the pistil itself, which is a peculiarity of orchids. The anther is the essential part of the stamen; the filament serves merely for its support. The anther is attached to the filament in various ways, sometimes firmly, or even as covering the mere extremity of its surface, and sometimes by an extremely slender neck, so as to be liable to be shaken by the slightest breath of wind, or by the touch of the smallest insect. The anther, when matured, which it is when the flower is in full perfection, produces *pollen*.[3] Pollen is a fine dust, which, when examined by the microscope, is seen to consist of minute cells. The anther consists of two lobes, corresponding to the two sides of the blade of a leaf, and these both produce pollen. Pollen is produced in cells or cases, which burst and scatter it. It is essential to the fecundation of flowers—that is, to make them productive of seed; and in order to this, it must be applied to the stigma, through which the minute pollen grains find their way to the germen and its ovules. The fecundation of plants is often very much assisted by insects, which stir the stamens, and set the pollen afloat in the air. In some plants, the stamen has a peculiar property called *irritability*, so that when the filament is touched, it moves, and closes upon the pistil, as may be seen in the barberry, the stamens of which can readily be made to move in this way by touching them near the base with the point of a needle. The stamens and pistils are ordinarily found in the same flower, arranged as already described, the stamens forming the whorl which immediately surrounds the pistils: such flowers are called *hermaphrodite*.[4] In many plants, however, there are flowers which have stamens only, and other flowers which have pistils only, and the flowers are then described as *male* and *female* flowers. The pollen of the male flowers is often extremely abundant, and is carried about in the air, as may be seen in the hazel, from which it may be driven off in clouds by shaking the branches at the time of flowering. The male flowers of the hazel are in long yellowish-white catkins, which have a very beautiful appearance as they hang from the branches in early spring, before the leaves are expanded; the female flowers are small and red, situated at the tips of buds. Plants which have the stamens and pistils in different flowers on the same plant, as the

1 From Latin *filum*, a thread. 2 From Greek *anthos*, a flower. 3 Latin, 'dust.'
4 That is 'of both sexes.' The word is derived from the mythological story of *Hermaphroditus*, the son of *Hermēs* (Mercury) and *Aphroditē* (Venus), who, when bathing, grew together with a nymph into one person.

hazel, are called *monœcious*;[1] but there are also plants which have the male and female flowers on separate plants, as the date-palm and the hemp, and these are called *diœcious*.[2] Flowers which have both stamens and pistils are called *perfect* flowers, because all the essential parts of the flower are found in them. In some such, however, the calyx or the corolla is awanting; and there are flowers which have none of these envelopes, but consist of stamens and pistils only: such flowers are described as *naked*. A flower which has calyx, corolla, stamens, and pistils, is called *complete*.

The parts of a flower are variously arranged. The leaves of the calyx and corolla, the sepals and petals, are sometimes opposite to one another, sometimes alternate, and a similar diversity appears in the inner whorls. Not unfrequently there are two or more stamens for each petal, and sometimes many; and the stamens are sometimes in bundles, as if many were formed by the division of a single leaf. Some of the whorls which form a flower often consist of a number of parts, which is a multiple of the number that characterises the flower, making it trimerous, pentamerous, &c.—as six instead of three, or ten instead of five. This regularity of numerical arrangement is called the *symmetry* of flowers. A flower in which the parts of each whorl are equal and similar, or nearly so, is called a *regular* flower, as the flower of the crocus or primrose. Many flowers, however, are irregular. Sometimes one leaf of the calyx is more developed than the rest, and assumes a different form; this more frequently occurs in the corolla, and sometimes in the stamens. The flower of a true geranium is regular; but the flower of a pelargonium, which is very nearly allied to a geranium, and is often called by that name, is irregular, the five petals of the flower appearing as two upper and three lower petals, with some difference of size and form. In the flowers of many orchids, irregularity may be said to be carried to its extreme. Some irregular flowers assume peculiar forms, and some of these are characteristic of certain orders of plants. Thus, the form called *papilionaceous*,[3] because of its resemblance to a *butterfly*, prevails generally in an order of plants containing a multitude of species, and producing their seeds in pods, of which the pea is an example.

Fruit.—The matured carpels of the flower form the *fruit* of a plant, and the matured ovules the seeds. Sometimes the fruit consists only of a single carpel, which contains only one seed, or a number of seeds; sometimes of a number of carpels belonging to the same flower, which are either separate or closely united together, so as to form one seed-vessel, or *pericarp*.[4] In pines and firs, there is no seed-vessel, but the seeds are protected by scales. The fruit is sometimes formed not merely

[1] From Greek *monos*, one, and *oikos*, a house.
[2] From Greek *dis*, twice, and *oikos*, a house.
[3] From Latin *papilio*, a butterfly.
[4] From Greek *peri*, around, and *karpos*, fruit.

of the pistil, but of other parts of the flower united with it. Thus, the calyx, which in some plants falls off during or immediately after flowering, is permanent in others, and remains attached to the fruit. The whole of a ripe fruit is often dry and hard, the softest part being the seed itself; but in other fruits, some part enlarges and becomes succulent, as in the apple, pear, plum, &c.; and a soft pulpy substance is formed in the interior of some fruits, as the gooseberry, grape, and orange. When the fruit is ripe, it often opens to scatter the seeds, which takes place in a great variety of ways, some of them very curious. Soft fruits, however, fall off entire when ripe, and the seeds are set free by the decay of the soft parts, or when they are eaten by birds or other animals, by which they are often carried to a distance so that the plant may be produced in a new situation. Among the provisions of nature for the dispersion of seeds are wing-like appendages with which some are furnished, so that they are readily wafted about by the wind. The down attached to the seed of a thistle is an appendage of which this is the obvious use. It is called the *pappus*,[1] and assumes various forms. In the dandelion, it consists of a stalk, from the summit of which hairs radiate; and the pappus stalks produced from a head of flowers are so regular in length, that their hairs, spreading out and touching each other, form a beautiful globe. The pods of some plants, as the broom, burst with considerable force when ripe, so as to fling the seed away from the parent plant, and in a warm summer day, the sound of the cracking of the pods may be heard at a considerable distance. The seed-vessels of the poppy exhibit a very different provision for the accomplishment of the same object. They resemble little urns, which have a row of small holes around them, just under the top; and the seeds, which are very small and very numerous, are scattered through these holes when the stem of the plant is shaken by the wind, as pepper is shaken out of a pepper-box. The great seeds of the cocoa-nut palm are wafted by the waves and currents of the ocean from one tropical coast to another, protected from the water by their thick husk and firm shell.

A fruit is generally formed from the pistil of a single flower, but the pistils of a number of flowers growing close together sometimes combine to form one fruit, as in the pine-apple, mulberry, and fig, the fleshy parts coalescing together.

Different kinds of Fruits.—There are so many different kinds of fruits, that a complete enumeration and description of them cannot be attempted here. Only a few of the most common and important can be noticed. A pear or an apple is a *pome*, so called from the Latin *pomum*, an apple, and is formed of two or more carpels. In the centre are cartilaginous or bony cells, containing the seeds, with a fleshy mass around them. A

[1] From Greek *pappos*, down.

plum, cherry, or peach is a *drupe*.[1] Fruits of this kind, popularly called stone-fruits, have one seed, or sometimes two seeds, surrounded by a hard shell, and around this is a fleshy covering. A *berry* is a fruit having the seeds amidst a fleshy or pulpy mass, as in the gooseberry and currant. The grape, the orange, lemon, &c., and the melon, cucumber, &c., afford examples of kinds of fruit closely allied to the true berry. A *pod* or *legume*[2] is a dry fruit, opening along two edges, so as to split into two halves, to which the seeds are attached. The name *pod* is also often given to the *silique*,[3] which differs from the legume in having a central piece, from which the valves part when the fruit is ripe, leaving the seeds attached to it, as may be seen in the kale, the turnip, the wall-flower, and all the large order of plants to which these belong. A *capsule*[4] is a dry fruit, which assumes a very great variety of forms in different plants, and sometimes opens along its whole length by valves, sometimes along part of its length from the top, so that, when open, it is toothed; sometimes by pores, as in the case of the poppy already noticed; and sometimes by throwing off a lid. A *nut* is a dry one-seeded fruit, with a hard shell which does not open.

Seed.—A seed usually consists of a nucleus or kernel, protected by integuments. The nucleus is often entirely formed of the *embryo* destined to become a new plant; and in this case, the whole store of matter necessary for the nourishment of the young plant in the commencement of its growth is contained in the embryo itself; but in many seeds there is a separate store of matter for this purpose, called the *albumen*,[5] which also forms part of the nucleus. The presence or absence of the albumen is a distinguishing character of many kinds of plants. The albumen is sometimes so large that the embryo forms only a small part of the seed; sometimes it is horny and hard, as in the vegetable ivory, a species of palm; sometimes it is farinaceous, as in wheat and other corn-plants; sometimes it is rich in oil, as in the poppy. The structure of the embryo itself does not depend upon the presence or absence of albumen. When we take off the integument of a pea or of a bean, seeds that have no albumen, the embryo is at once fully exposed to view, and we find it to consist of two lobes, united together at one point, from which the radicle and the plumule are to spring, the same point that the seed itself grew from, and by which it was attached to the parent plant. These lobes are called *seed-leaves* or *cotyledons*[6] (*a*, *a*, fig. 72, page 108), and in some plants,

[1] From Greek *drupetēs*, quite ripe, from *drys*, a tree, and *piptō*, to fall.

[2] Latin *legumen*, from *lego*, to gather, so called because the seeds are *gathered* or attached to only one suture or seam.

[3] Latin *siliqua*, a pod.

[4] Latin *capsula*, a little case, diminutive of *capsa*, a case.

[5] A substance like the *white* of an egg, from Latin *albus*, white.

[6] Greek, 'a cup-shaped leaf,' from *kotylē*, a cup.

as the scarlet runner, they come above ground when the young plant begins to grow; in others, as the bean and pea, they remain underground. Cotyledons exhibit a great variety of forms, and are sometimes wrinkled, curved, folded, or twisted. Those of the potato are spiral. Cotyledons are sometimes split into parts, as in firs, so that a seed appears to have many cotyledons instead of two. Plants of which the seeds have two cotyledons are called *Dicotyledonous*, from the Greek *dis*, twice. Those of which the seeds have only one cotyledon are called *Monocotyledonous*, from the Greek *monos*, one. These terms designate two great classes of plants, which include all the higher kinds of plants; but the lower kinds have an embryo entirely cellular, which is called a *spore*,[1] and gives forth a new root or stem from any part of its surface, according to the circumstances in which it is placed, and not necessarily from a particular point, as is the case in a monocotyledonous or dicotyledonous seed. Such plants are designated *Acotyledonous*, from the Greek privative *a*. There is a remarkable correspondence between the structure of the seed and the structure of the stem, so that *exogenous* plants are *dicotyledonous*, *endogenous* plants are *monocotyledonous*, and *acrogenous* plants are *acotyledonous*, and into these three great classes all plants are divided.

Classification of Plants.

About 120,000 species of plants are known, some of them so minute, that they are mere objects of microscopic examination, while others are of vast magnitude. The great object of botanists in their systems of classification is to exhibit the scheme of nature itself; and this is in a great measure accomplished by the division of plants into the three great classes just mentioned. Plants which have much agreement in structure and characters, are grouped together as forming one *order*, and those in which the resemblance is still closer as forming one *genus*.

Acrogenous Plants.—Of the lowest class of plants, known as *Acrogenous*, *Acotyledonous*, or *Cryptogamous*,[2] which have no flower, the lowest of all are found in the order *Algæ* [Latin, 'sea-weeds or water-weeds']. These abound both in the sea and in fresh water in all parts of the world. Some sea-weeds attain a great size, exceeding in length the tallest forest trees. They have no root, but are merely attached by their base to rocks, imbibing all their nourishment from the water in which they float. Some of the *Algæ* are used for food, as *dulse* and *carrageen* or *Irish moss*. Some of the larger sea-weeds are valuable as yielding *kelp*, which is obtained by burning them. Kelp, the ashes of sea-weed, contains a large

[1] From Greek *sporos*, seed.

[2] So called from their fructification being concealed, from Greek *kryptos*, concealed, and *gamos*, marriage.

quantity of soda, and was formerly much used in the manufacture of glass.

Fungi[1] are another order of the lowest kind of plants. Of this the mushroom is an example. All the *Fungi* are short-lived, they grow very rapidly, and soon decay. They do not live in water, but generally in moist situations. Many of them are very small, as the different kinds of mould which grow upon decaying animal or vegetable substances. Many of the larger fungi are pleasant and wholesome articles of food, as the common mushroom, the truffle, and the morel. Some of them, however, are very poisonous, and fatal accidents not unfrequently happen from the mistaking of one kind for another.

Another large order is that of *Lichens*, 'plants that lick up moisture' [Greek *leichēn*, from *leichō*, to lick]. Some of them form mere crusts upon the stone or bark on which they grow; some are expanded in a leaf-like manner; others form filaments and tufts. Lichens growing on rocks may be said to begin the process of forming a soil for other plants. *Iceland moss* is an example of a lichen used for food. Another kind, popularly known as *reindeer moss*, affords the chief winter-food of the reindeer in Lapland and other arctic countries.

Ascending in the scale of plant-life to the true acrogenous plants which have stems, roots, and leaves, the first order which demands special notice is that of *Mosses*, which chiefly abound in cold and moist regions. They are all small plants, but vast multitudes often grow together, covering the ground with a green carpet.

Another great order of acrogenous plants is that of *Ferns*. The largest ferns, those which become trees, are found only within or near the tropical regions. Few ferns are of much use to man, but their great beauty has led to their very general cultivation, not only in gardens and greenhouses, but in rooms of houses.

Endogenous Plants.—The two most important orders of Endogenous or Monocotyledonous plants are *Palms* and *Grasses*. Palms are only found in warm countries, and mostly within the tropics. The palm frequently mentioned in the Bible is the *date-palm*, which extends into more northern regions than almost any other species. Palms, in general, have tall stems, often shooting above the other trees of a tropical forest, and waving their great leaves in the air. Some of them, however, have very short stems, and some have very long slender stems, which clamber over trees, and depend upon them for support. Such are the *rattans* of the East Indies, the stems of some of which far exceed in length the most stately trees of the forest. Rattans are much used for making cane-bottomed chairs and for other kinds of wicker-work. The stems of some palms are used in house-building, and for other purposes; the great leaves are used for thatching,

[1] Plural of Latin *fungus*, a mushroom.

and often in Eastern countries as umbrellas; the fibres of various parts are used for cordage and clothing; the sap of some species is used as a beverage, and when fermented, resembles a kind of beer or wine —the *toddy* of India, from which, by distillation, a kind of spirit called *arrack* is obtained; the soft internal part of the stem of some species yields *sago*, and a few species are valuable for their fruit. The most important of these are the date-palm and the cocoa-nut palm. The date-palm supplies the inhabitants of Egypt and many other countries with a great part of their food. The cocoa-nut palm is found on the sea-coast of all tropical countries. The nut is valuable as an article of food and for the oil which it yields; and from the husk a kind of cordage is made, called *coir;* it is also much used for the manufacture of matting.

Grasses clothe a great part of the surface of the earth. To this order belong all the corn-plants, of which the most important are wheat, barley, oats, rye, rice, maize, and millet. Grasses are in general herbaceous plants with hollow jointed stems; but some tropical species, as bamboos, become shrubs or trees. Grasses afford the greater part of the food of oxen, sheep, and other herbivorous animals. The seeds of the corn-plants or *cereal*[1] grasses also supply a principal part of human food. The stems of bamboos are used for various purposes, as timber for the construction of houses, as pipes for conveying water, &c.

Only a few of the other orders of endogenous plants can be mentioned here. The order *Liliaceæ*, as its name implies, contains *lilies* and many other plants remarkable for the beauty of their flowers. To this order belong the medicinal plants called aloes and squills, also the flax-lily of New Zealand, from the leaves of which is obtained the valuable fibre called New Zealand flax.—The order *Amaryllidaceæ*, from Latin *amaryllis*, the snowdrop, contains a great number of species having very beautiful flowers, among which are the narcissus, jonquil, and snowdrop. Some useful plants belong to this order, as the onion and leek, and the American aloe, the leaves of which yield a fibre useful for cordage, and the juice of the flower-stem a beverage much used in Mexico, called *pulque*.—The order *Iridaceæ*, of which the *iris* and crocus are examples, is chiefly notable for the beauty of its flowers.—An important order of plants, all natives of warm parts of the world, bears the name of *Musaceæ*, from Latin *musa*, the plantain-tree. The plants of this order are among the largest of herbaceous plants, and false stems formed by the stalks of their great leaves give them the appearance of trees. The banana and plantain belong to this order. The plantain is used in many tropical countries as a substitute for bread; and of all the plants which supply human food, it is by far the most productive. The leaves of some of the *Musaceæ* yield a useful fibre, and that of one species, a native

[1] So called from *Ceres*, the Grecian and Roman goddess of corn.

of the Philippine Islands, has become a considerable article of commerce, under the name of *Manilla hemp*.—Orchids (*Orchidaceæ*) are a large order of endogenous plants, generally remarkable for the beauty as well as the curious structure of their flowers.

Exogenous Plants.—We now come to Exogenous plants, but of these the orders are so numerous that many which contain valuable species must be left unnoticed. A very important order, *Coniferæ* [Latin, 'cone-bearers'], contains pines, firs, larches, cedars, araucarias, junipers, &c. Among the *Coniferæ* are the tallest trees in the world, such as the great pines of California (*Wellingtonia gigantea*),[1] which attain a height of 300 feet or more, their stems rising erect almost to the very summit, and without a branch for almost half their height from the ground. Many of the *Coniferæ* are very valuable for their timber, which is remarkably resinous. From trees of this order we obtain also turpentine, tar, and pitch.

The *Amentaceæ*, from Latin *amentum*, a catkin, are so called from having their flowers in catkins, as willows, poplars, birch, alder, hazels, oaks, beeches, chestnuts, walnuts, &c. It will be seen, from the examples named, that among the *Amentaceæ* are many noble and beautiful trees, and some which are valuable for their fruits. They abound chiefly in the temperate parts of the world. Both the *Coniferæ* and *Amentaceæ* are destitute of corolla. The order *Urticaceæ*, from Latin *urtica*, a nettle, contains a great number of species, of which the nettle is an example. Many of the species have stinging hairs; and some Indian nettles sting with a severity far beyond that of the nettles of Britain. Yet the common large nettle of Britain, when gathered young and boiled, is perfectly wholesome, and nettle-broth was at one time in common use in Scotland. Hemp, which yields one of the most valuable of fibres, is nearly allied to the nettles, as is also the hop, of which the flowers are used for flavouring beer.

Closely allied to the *Urticaceæ* is the order *Moraceæ*, from Latin *morum*, the mulberry, to which the fig and the mulberry belong. The species are generally trees, and chiefly abound in warm countries, in which many species of fig are found, some of them rapidly covering ruined buildings with their branches and foliage. The banyan, already noticed, is a species of fig. The fruit of the common fig is very superior to that of any other of its genus. The sycamore, sometimes mentioned in the Bible, is another species of fig, the fruit of which is a common article of food in Egypt and Syria. Some species of this order yield abundantly caoutchouc or india-rubber.—To these orders, that called *Ulmaceæ*, from Latin *ulmus*, an elm, is also allied. It consists of trees and shrubs, of which the elms are examples. They have rough leaves, and are valuable as ornamental and timber trees.—The only other order which

[1] Named after the late Duke of Wellington.

it seems necessary to notice of the large group of exogenous plants destitute of corolla, is that called *Piperaceæ*, from Latin *piper*, pepper, to which the true pepper-shrubs belong, although Cayenne pepper and Jamaica pepper are the produce of plants of very different orders. They are generally small shrubs or herbaceous plants with jointed stems.

The orders of exogenous plants which remain to be noticed have generally both calyx and corolla. The order *Ranunculaceæ* consists chiefly of herbaceous plants, generally with a large number of stamens, most abundant in the colder parts of the world and in moist climates. To this order belong the *ranunculus*, anemone, and many other plants highly esteemed for the beauty of their flowers, and some which are of use in medicine, as aconite and hellebore.—The order *Nymphæaceæ*, from Latin *nymphæa*, the water-lily, consists of the plants commonly called *water-lilies;* their leaves are large, and float on the water. To this order belongs the *Victoria regia* (fig. 79, page 134), a South American plant, remarkable for the great size of its leaves and flowers, and for the cultivation of which special hot-houses have been erected in some gardens of Britain. The flowers of water-lilies are often both very beautiful and very fragrant, as in the case of the common white water-lily of Britain, and the blue water-lily or *lotus* of the Nile. They generally float on the water as the leaves do.—Another order closely related to these is *Papaveraceæ*, from Latin *papaver*, the poppy, to which poppies belong. Poppies are not only notable for their large showy flowers, but their seeds are edible, and yield a useful oil. The unripe capsules also contain the substance called *opium*, much used in medicine.

The order *Cruciferæ*[1] is a very large one, containing a great number of species, mostly herbaceous plants, natives of temperate and cold countries. To this order belong the kale—with the cabbage, cauliflower, broccoli, Brussels sprouts, and kohl rabi, which are mere varieties of the same species, variously modified by cultivation—the turnip, rape, radish, sea-kale, cress, water-cress, mustard, wall-flower, rocket, stock, honesty, and many other plants cultivated for various uses in fields and gardens, or esteemed for the beauty of their flowers. A peculiar pungent taste is very characteristic of this order; it is almost unperceived in the leaves of the cabbage or in the root of the turnip, but gives their most esteemed qualities to the root of the radish, the leaves of the cress, and the seed-leaves of mustard used as a salad, and is most perfectly developed in the seeds of mustard.—The order *Violaceæ* contains the beautiful plants called *violets*, some of which are much cultivated in flower-gardens under the name of *pansies*. Some plants of this order are valuable for their

[1] 'Cross-bearing,' from Latin *crux, crucis*, a cross, and *fero*, to bear, so called from their flowers, petals, or other parts being arranged in the form of a cross.

medicinal properties, particularly the ipecacuanha, which grows in the tropical parts of South America.

The order *Caryophyllaceæ*[1] is a large one, consisting of herbaceous plants with jointed stems swollen at the joints. Examples of it are found in the common chickweed, and in the pinks and carnations of our gardens.—In the order *Malvaceæ*, from Latin *malva*, the mallow, the leaves are in general palmate—that is, they are divided as a hand spread out into fingers—and all the soft parts are generally mucilaginous. The leaves of some are used for food. The mallow and hollyhock are examples of this order. The stems of some of the *Malvaceæ* yield useful fibres; but the most important species of the order are the cotton-plants, the valuable fibres of which are produced in their seed-vessels.—The order *Tiliaceæ*, from Latin *tilia*, the linden-tree, contains trees and shrubs resembling *Malvaceæ* in their fibrous and mucilaginous properties. To this order belongs the linden or lime tree, so common an ornament of pleasure-grounds. This tree abounds in some parts of Europe, particularly in the west of Russia, and *bast-mats* are made from its inner bark. An Indian plant of this order yields the fibre called *jute*, an important article of commerce, and used for manufacturing purposes like flax and hemp.

The order *Ternstræmiaceæ* contains the tea-plants, shrubs which are natives of China, Japan, and Assam, and the leaves of which, dried in a peculiar manner, are *tea*. The flowers of this order are generally very beautiful, and the *camellias*, so much cultivated in our green-houses, belong to it.—Oranges, lemons, and citrons belong to the order *Aurantiaceæ*, from Latin *aurantium*, an orange, which consists of trees and shrubs, all natives of Asia, although some of them have long been cultivated in other parts of the world. The fruit of most species of this order is pleasant and refreshing; some kinds are very acid, but their juice is valuable in tropical countries as a preventive of fevers, or when diluted with water, as a beverage.—The order *Aceraceæ*, from Latin *acer*, the maple, contains the maples, trees of Europe and other temperate countries. The sycamore, a common tree in Britain, often called the *plane-tree*, although it is not the true plane-tree, but only somewhat like it, belongs to this order. The sap of maples abounds in sugar; and that of one species, called the sugar-maple, yields the *maple-sugar* of North America.—The order *Cedrelaceæ*, from Latin *cedrus*, the cedar, consists entirely of trees, natives of warm countries, of which the most important is the *mahogany-tree*, a native of the warmest parts of America, extremely valuable for its timber.—The order *Vitaceæ*, from Latin *vitis*, the vine, consists of climbing shrubs, one species of which, the grape-vine, is of great importance on account of its fruit, the *grape*, which,

[1] From Latin *caryophyllus*, the clove-tree.

when dried, is the *raisin*, and from the juice of which wine is made. Another well-known plant of this order is the *Virginian creeper*, often employed to ornament the walls of houses.—The order *Geraniaceæ* consists of shrubby and herbaceous plants, many of which have flowers of great beauty, esteemed ornaments of our gardens and greenhouses, as geraniums and pelargoniums.—Nearly allied to this is the order *Linaceæ*, from Latin *linum*, flax, to which flax belongs. The order is important chiefly on account of this species.

The order *Leguminosæ*, from Latin *legumen*, a pod, is one of the largest orders of *phanerogamous*[1] or flowering plants. Some of its species are trees of great size; some are very small herbaceous plants. The fruit is generally a pod, and the flowers are generally papilionaceous. Many useful plants belong to this order; some of them trees valuable for their timber, or as yielding dye-stuffs, of which logwood and Brazil-wood are examples; some for their foliage, as clover and lucerne; some for their seeds, which are used for food, as the pea, bean, lentil, kidney-bean, and chick-pea. One of the most important of dye-stuffs, indigo, is obtained from the leaves and stems of certain herbaceous species of this order, some of which are extensively cultivated in India.—Nearly allied to the *Leguminosæ*, notwithstanding great differences both in the flowers and in the fruit, is the order *Rosaceæ*. The *rose* gives its name to this order, and the flowers have generally an appearance somewhat resembling it. It contains trees, shrubs, and herbaceous plants, natives of tropical, temperate, and cold countries. Many of the most esteemed fruits belong to it, as the apple, pear, quince, medlar, loquat, plum, cherry, peach, nectarine, almond, raspberry, and strawberry. The fruit of some of these is a *drupe*, that of others a *pome;* whilst the rose, the raspberry, and strawberry afford examples of other kinds of fruit very different from these and from each other.—Another large order is that called *Myrtaceæ*, to which the *myrtle* [Latin *myrtus*] gives its name. It consists of trees and shrubs, mostly natives of the warmer parts of the world, and generally very beautiful. Some of them have eatable fruits, as the pomegranate and the guava; some yield fragrant substances. *Cloves* are the flower-buds of a species of this order; *pimento* or *Jamaica pepper* is the fruit of another.

Gourds, pumpkins, cucumbers, and melons belong to an order called *Cucurbitaceæ*, from Latin *cucurbita*, a gourd. It consists of climbing plants, mostly herbaceous, with large coarse leaves, natives of the warmer parts of the world. Acrid properties prevail in this order, and some of the species are poisonous. The medicine called *colocynth* is obtained from the fruit of one. The leaves of some, however, are used for the table as greens, and the fruit of a number of

[1] From Greek *phaneros*, apparent, and *gamos*, marriage—opposed to *cryptogamous*.

species is wholesome and pleasant. The melon, cucumber, water-melon, and vegetable marrow are particularly esteemed. Some kinds of gourd and pumpkin attain a very large size, and are an important article of food in many countries.—The *Cactaceæ*, from Latin *cactus*, the artichoke, are a large and remarkable order of succulent plants, all natives of America. Most of them have no leaves, the green surface of their stems and branches serving the purposes of leaves. Their stems assume many remarkable forms; they are often very spiny, and are employed in some countries for hedges. Some of them are very common in hot-houses in Britain, being cultivated not only on account of their curious appearance, but of the great beauty of their flowers. The fruits of some are eatable, particularly that of the prickly pear, which is now common in the south of Europe. It is on a plant of this order that the cochineal insect lives, and the plant is cultivated for the sake of the fine dye-stuff which the insect yields.—Allied to the order *Cactaceæ*, although very different in appearance, is the order *Grossulariaceæ*, from Latin *grossus*, an unripe fig, which consists of shrubs found in the temperate parts of the world. The gooseberry and currant are examples.

The order *Umbelliferæ* [Latin, 'umbel-bearers'] is a very large one, peculiar in its characters, and remarkable for its prevalent properties. It consists almost entirely of herbaceous plants, some of which are of very large size, and many of them of coarse appearance. The flowers are produced in *umbels*, and are generally very small, although the umbels are often large, and consist of a great number of flowers. The fruit is formed of two carpels, each producing one seed. The plants of this order very often have a strong smell, which in some is aromatic and agreeable, in others very disgusting. Many species are poisonous, of which hemlock may be mentioned as an example. Some of the poisonous species, however, yield useful medicines. The leaves and leaf-stalks of a few species are used as salads and pot-herbs, being valued chiefly on account of their flavour, as celery and parsley. The roots of some umbelliferous plants, as the carrot and parsnip, become large and fleshy in favourable circumstances, particularly under cultivation, and are valuable articles of food. The seeds of some, as caraway and coriander, are aromatic and agreeable.

A large order, containing trees, shrubs, and herbaceous plants, mostly natives of warm countries, is called *Cinchonaceæ*;[1] they have generally very beautiful foliage, and some of them have beautiful flowers. The coffee-tree belongs to this order; it is a native of Arabia, but is now extensively cultivated in many warm countries. The *coffee-bean* is its seed. Certain trees of this order, belonging to the genus *Cinchona*, yield the substance called *Peruvian bark*, from which *quinine*, one of the most

[1] From the *Cinchona*, so called after the Countess del Cinchon at Lima, who was cured by its use in 1638.

valuable of medicines, is extracted. These trees are all natives of the north-western parts of South America, growing on the slopes and in the valleys of the Andes.

A very large order of plants is called *Compositæ* [Latin, 'composite or compound'], because the flowers are grouped very closely together into heads, so that the whole head appears as one flower. This order contains many species prized for the beauty of their flowers, as daisies, chrysanthemums, marigolds, dahlias, and asters. The leaves of some are used as salads, as those of the lettuce and endive. The roots of others are eaten, as those of the salsafy and scorzonera; and the roots of the Jerusalem artichoke, which is a species of sunflower, produce tubers like the potato. The roots of chicory, dried and ground into powder, are used as a substitute for coffee, or for mixing with coffee. The receptacle of the head of flowers—the enlarged summit of the flower-stalk—is the eatable part of the artichoke; it is the same part which boys know as the *cheese* of thistles. Thistles belong to this order.

Heaths belong to the order *Ericaceæ*, from Latin *erica*, heath. The species of this order are very numerous. They are shrubs with evergreen hard leaves and extremely beautiful flowers. Many of them are what are called *social plants*, that is, multitudes of them grow together; and some of the species cover great tracts of country, as the common *heather* of British moors. To this order belong also *rhododendrons*,[1] or rose-trees, so called from the likeness of their flowers to the rose. —The olive gives its name to the order *Oleaceæ*, from Latin *olea*, an olive, to which the ash, the lilac, and the privet also belong. All the species of this order are trees and shrubs, natives of temperate countries.

The order *Solanaceæ*, from Latin *solanum*, the nightshade, is particularly important as containing the potato. No other plant of the order produces edible tubers; but the fruits of some are used, as those of the egg-plant and the tomato or love-apple. Poisonous qualities, however, generally prevail throughout the order. The species of *capsicum* are small shrubby plants of this order, remarkable for the pungency of their fruit, which far exceeds that of pepper. The berries of capsicums, often called chillies, are pickled to make *hot pickles*, and when dried and powdered, they become *Cayenne pepper*. Henbane belongs to this order, which also contains the *deadly nightshade*, the berries of which are very poisonous, and are sometimes unhappily eaten by children, who mistake them for blackberries. This order also produces tobacco, which is made of the leaves of several species of a genus called *Nicotiana*, from Nicot, who introduced tobacco into France in 1560.—The order *Scrophulariaceæ*, so called from the resemblance of their roots to scrofulous tumours, contains a great number of species,

[1] From Greek *rhodon*, a rose, and *dendron*, a tree.

mostly herbaceous, some of which are found in almost all parts of the world. Perhaps the most important of them is the foxglove or *digitalis*, which is used in medicine. Many of them have flowers of considerable beauty, as the calceolarias, veronicas or speedwells, and antirrhinums or snapdragons. The flowers of the *Scrophulariaceæ* have very often more or less that peculiar form which is seen in the calceolarias and antirrhinums.

Another large order is that of *Labiatæ*, from Latin *labium*, a lip, in which also the corolla generally divides into two parts or *lips*. The plants of this order are mostly herbaceous plants or small shrubs, and many of them are remarkable for their fragrance, which is due to an essential oil abounding in their leaves. Some of them are used in cookery for flavouring, some in perfumery, and some in medicine. As examples of this order, it is enough to name mint, thyme, lavender, patchouli, sage, hyssop, rosemary, marjoram, basil, and savory.—The order *Verbenaceæ* contains the beautiful flowers cultivated in our gardens under the name of *verbena* [Latin *vervain*], and the shrub common not only in greenhouses but in cottage windows, which generally receives the same name, remarkable for its orange-like fragrance. It contains also the teak-tree of India, one of the most valuable of timber-trees.—The last order which we shall notice is *Primulaceæ*,[1] an order consisting of herbaceous plants, none of which are of large size, but which generally have very beautiful flowers. They are mostly natives of temperate parts of the northern hemisphere. The primrose, the cowslip, the auricula, and the pimpernel are examples of this order.

[1] From *primula*, the primrose, from Latin *primulus*, very early, so called from its flowering in the beginning of spring.

Fig. 79.—Victoria regia, flower and leaf.

GEOLOGY.

Nature of the Subject.

We have most of us stood at the base of a great cliff, and looked upwards with awe at the rocks exposed on its weathered front. Such a sight might suggest many strange and interesting inquiries. How did these rocks come to be where they are? Of what are they composed? When were they formed? Whence the material for the vast thickness of rock that composes the crust of the earth? Whence have come the varied substances that form our limestones, coals, and sandstones? Whence also the strange shells, plants, and animals that a closer examination of their structure reveals? Are these the remains of bygone living organisms, or are they only marks in the rocks themselves? If they were once living creatures, what were their structure and habits? Such questions suggest themselves to every thinking person, whether man or boy, and such questions Geology undertakes to answer; and it is to the principles of this great science that we now proceed to direct attention.

Geology, from the Greek *ge*, the earth, and *logos*, a description, is, according to its name, a description of the earth. It examines the various rocks that compose its crust, and seeks to explain their appearance, form, structure, relative position, formation, age, and distribution throughout the globe. It also inquires minutely into their contents, animal, vegetable, and physical; the causes of their imprisonment in their stony tombs; and the structure and habits of the creatures there found. It pictures forth the physical history of the globe during the successive epochs through which it has passed, with their varied scenery and inhabitants, the formation of its many strata, and the structure and progress of the organic forms that successively waved in its atmosphere, moved over its surface, or swam in its seas. In short, it is the province of Geology to describe the whole natural history of the globe during the various ages of the long past; and it includes the zoology,

botany, mineralogy, and geography of the ancient earth, whose present conditions are the result of the numberless changes through which it has passed in these geological eras. The past it seeks to interpret solely by the present, assured that the laws of nature are invariable and universal, and that causes operating now produced like effects in the primeval earth.

Rocks, their Kinds, Structure, and Disposition.

In order to speak with precision in our study of this subject, it is necessary to have a distinct idea of what a rock is in Geology, and to understand certain things regarding their kinds, structure, and arrangement.

What a Rock is in Geology.—In Geology, the word ROCK has a wider meaning than it has in common language, where it means a mass of stone of considerable size. In this science, the word ROCK is used to designate *any of the materials that compose the crust of the earth*, of whatever size and softness they may be. Geologists reckon sandstone, marble, quartz, granite, and limestone to be *rocks*, as others do; but they also speak of coal, gravel, chalk, sand, salt, peat, and like soft and broken substances, as *rocks* or rock-formations.

Kinds of Rocks.—Rocks have different names, according to their appearance and structure. Every one knows what *sand* is, and that it varies greatly in fineness. The most of the sand we see is composed of small particles of rock ground to powder, but it often consists, as we shall afterwards learn, of numberless very minute shells. *Sandstone* is the usual rock of which houses are built, and which, in thin layers, is used for pavement. This rock is more common than any other, and has many varieties, and is, of course, so called because it is composed of particles of *sand* that have been made to cohere. When the particles of the sandstone are somewhat larger and sharper, the rock is called *grit*, from the particles having been *grated* down or broken: the rock of which millstones are formed is called millstone-grit, and its value depends on the hardness and sharpness of the grains of which it is composed. When the particles are larger still, and form small stones that do not cohere, the rock is called *gravel*; and when yet larger and more rounded, *shingle*, examples of both of which occur on the sea-beach. A mass of broken angular stones thrown up in a heap, as by a river after a flood, is called *rubble*. A stone when small is called a *pebble*; when large, a *block*; and when rounded and worn, a *boulder*, because it is *ball*-shaped. The fine sediment at the bottoms of rivers, lakes, and pools is composed of ground mineral, animal, and vegetable matter. When this is tough and plastic, it is called *clay*,

because it *cleaves* or sticks; and the whole accumulation of mud, clay, and sand at the bottom of any water, is called *silt.*

The remains of vegetable matter found in various parts of the country, and used as fuel, are known as *peat;* and *coal* is nothing but such vegetable matter changed by heat, and hardened into rock by pressure. *Limestone* is the name given to the hard rock which, after being burned in a kiln, forms *lime.* When the limestone is hard and crystalline, it forms *marble,* which is of different colours, from deep black to pure white, and often beautifully variegated. *Chalk* is a variety of limestone, and obtains its name from this fact; the word chalk being another form of the Latin *calx,* lime.

Common *slate,* used for writing on and for roofing, is composed of thin layers of hard rock, of which some of our highest mountains are formed. The name *shale* is applied to a kind of rock which *shells* off or splits into very thin layers, and which may be seen in great heaps near coal-pits. Thin layers of sandstone used for pavement are called *flags.* The white pebbles so common on the sea-beach, and so easily broken, are made of *quartz,* and rock formed of it is called *quartz-rock.* Some varieties of quartz, called *rock-crystals,* are very beautiful and valuable, and become even precious stones, such as agate, amethyst, and topaz. *Flint* has much the same composition as quartz, and is very plentiful in chalk. The granular rock brought from Aberdeen and elsewhere, so beautiful when polished, is called *granite,* from its being composed of *grains* of other rocks. The particles that glitter like silver in the granite are pieces of *mica,*[1] which is so named because it *shines.* A mineral very like mica in appearance, but different in composition, is called *talc,* from its feeling somewhat greasy or *tallowy* when touched.

The molten matter that *flows* from volcanoes is called *lava;*[2] *pumice-stone*[3] is the *cinder* of such discharges; while the *ashes* that are thrown into the air are called *scoriæ.* In geologic times also there existed volcanoes from which lava issued; the rock this lava formed is called *trap,*[4] from lying in *stair*-like masses, as it flowed from the mountain; and one kind, *whinstone,* which is much used for roads. A common variety is known as *greenstone,* from its colour, of which Salisbury Crags, near Edinburgh, are composed. Another variety is called *basalt,* and is generally found in columns standing close together, which often form wonderful natural scenes, such as Fingal's Cave and the Giant's Causeway. Another variety is *porphyry,*[5] so called from its frequent *purple* colour, and is easily distinguished by its granular appearance. A kind of light porous rock, formed of cohering volcanic

1 From Latin *mico,* to shine.
2 From Latin *lavo,* to flow.
3 From Latin *pumex, -icis,* cinder.
4 From Latin *trappa,* a stair.
5 From Latin *porphyra,* purple.

ashes, is known as *trap-tuff*, or *tufa*, a word that comes from Italy, the seat of so much volcanic action.

Structure of Rocks.—On examining the rocks forming the crust of the earth, we find that they may be divided into two great classes—the *stratified*, or those deposited in strata or layers; and the *unstratified*, or those not so formed. Sandstone and slate are stratified rocks; granite and trap are unstratified.

1. *Stratified Rocks.*—Any thin deposit of rock is called a *layer*, from its having been *laid down* under water; a *band*, from its being like a thin band; a *bed* or a *stratum*, when of greater thickness, from Latin *sterno*, to spread; and a *seam*, when of a peculiar character as compared with the rocks near it, as a seam of coal. *Stratum*, with the plural *strata*, is the general term for any layer of rock, and hence all rocks in layers are said to be *stratified*. Rocks that split up into very thin layers, a great number being included in the thickness of an inch, are said to be *laminated*. When a rock is composed of rounded pebbles or boulders embedded in other matter, it is called a *conglomerate*, and sometimes, from its appearance, *pudding-stone* or *plum-pudding-stone*.

2. *Unstratified Rocks.*—Unstratified rocks assume various forms, according as they have been shot up amongst the stratified rocks; for, as we shall afterwards see, they have been erupted from volcanoes. Very often, like most volcanic substances, they are *porous* or *cellular*, like pumice-stone; frequently they stand together like gigantic columns, when they are said to be *columnar*, like basalt; and often they are found in large *globular* or *spherical* masses, like bombs or cannon-balls.

Disposition of Rocks.—1. *Stratified Rocks.*—When rocks lie parallel to the horizon, they are termed *flat* or *horizontal*, as A, in the following section; when at an angle to it, they are said to be *inclined* or *dipping*, as B; when one end has been thrown up by some other mass, they are said to be *tilted up*, as R; when so much inclined as to be straight up and down, they are said to be *perpendicular*, or *to stand on edge*. When inclined rocks come to the surface, they are said to *crop out*, and the exposed edge is therefore termed the *outcrop*, as M; the angle at which they are inclined is called the *dip* of the rocks, and is measured by the number of degrees from the horizontal in any direction, as 60° S.; and the line of the outcrop along the surface is termed the *strike* or *line of strike*, because it strikes or runs across the country. When the strata are not straight, they are said to be *bent* or *curved;* and when greatly bent, *twisted* or *contorted*, as P. When all the strata in a series lie at the same angle, they are called *conformable;* when at different angles, *unconformable*, as at A. Sometimes certain strata seem to have slipped or to have moved up, so that rocks that should be opposite to one another are not so. The portion that has slipped is naturally termed a *slip*, as C;

that which has been heaved up, an *upheaval* or *hitch:* where the strata at the slip lie at different angles, the slip is called a *fault*, as O. All such displacements of strata are known as *dislocations*, and they are much more frequent than the regular disposition of rocks on the surface of the earth. When strata are bent in wavelike undulations, they are said to *roll*, as H; and the hollow or concave portions are termed *troughs* or *basins*, and the elevated portions *ridges*, as I and K.

2. *Unstratified Rocks.* — These rocks are thrown up amidst the stratified, and assume different positions according to the manner of their upheaval. Where they throw the strata into various angles, the rock upheaved is termed the *disrupting* mass, as V; at other times, they overlie the other rocks, and are then called *overlying*, as E; they are also interjected *between* the other *strata*, and are said to be *interstratified*, as F. Sometimes they intersect the other strata by masses like walls, which are called *dikes*, as G; and sometimes the disrupting mass breaks into branches, which are called *veins*, as N.

When a broad face of rock is exposed, and the different rocks shewn, as in a cliff on the sea-shore, a railway-cutting, or a quarry, such exhibitions of strata are called *sections;* and these may be delineated on paper. Sections of the underlying rocks may also be made, by examining the different rocks in a country, though no section be exposed in nature.

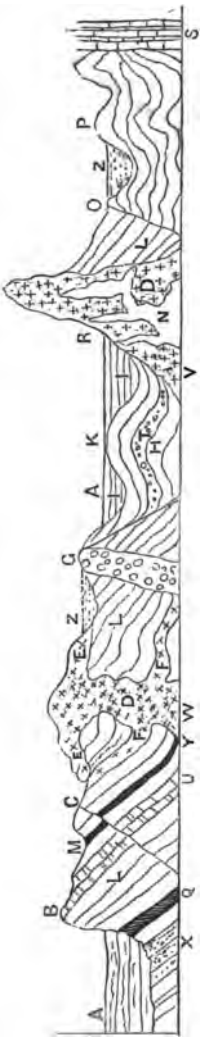


Fig. 80.—Section of the Different Kinds of Strata.

A, Horizontal and unconformable rocks.
B, Inclined strata.
C, A slip.
D, A disrupting mass.
E, Overlying trap.
F, Interstratified trap.
G, A dike.
H, Bent and rolling strata.
I, A basin or trough.
K, A ridge of rocks.
L, The dip of the rocks, 45°.
M, An outcrop.
N, Veins.
O, A fault.
P, Contorted or twisted strata.
Q, A seam.
R, Rocks tilted up.
S, Columnar basalt.
T, Conglomerate.
U, Limestones.
V, Granite, disrupting.
W, Trap.
X, Sandstones.
Y, Coal.
Z, Silt or gravel.

The Contents of the Rocks.

The contents of the rocks receive the general name of *fossils*, from the Latin *fossus*, dug, because they require generally to be *dug* out of the earth. Fossils may be divided into two great classes, animals and plants.

Fossil Animals.—In the rocks, we discover specimens of every class included in the animal kingdom. We find corals of all kinds, and of the most beautiful structure, some branched like some of the corals of the present seas, others standing in masses on the very spots where they lived and died, their remains giving beauty to our finest marbles. We see star-like creatures of all kinds, either spreading abroad their arms or curled up at rest, as they may be seen any day during the ebb of tide. Shells of every form, size, and colour meet us at every step, as distinct as we now find them on the shore; and some formations, of vast thickness and extent, are formed entirely of the habitations of these little creatures. We may also gather crustaceans, such as the crab and the lobster, the minutest parts of their structure being perfectly preserved. We discover fishes of every kind and size, sometimes entire, as they fell to the bottom at death, or crushed and broken in the convulsions to which the rocks have been subjected. We can gather the hard scales, that defended them like armour; can form collections of their teeth, their fins, their jaws, and their eggs; and can construct them again as they swam about in the ancient seas. Insects, too, we can gather of every kind, and can see them as they flew about in the old forests and got entangled in the resin of the great old trees. Birds, too, are found, though not so plentifully as other creatures, as, from their manner of life, they were not so easily carried down by rivers, and deposited in the mud at their mouths. We find reptiles of immense size, crocodiles, and lizards, and flying dragons, with their terrible teeth, sweeping tails, and adamantine hides. We come upon beasts of every size, from little creatures that burrow in the ground, to gigantic deer, elephants, rhinoceroses, and mammoths; and may enter the very dens in which lived beasts of prey, and to which they bore their captured victims.

These creatures differ more or less from those that now inhabit the globe, but they are members of the same classes; and catalogues of them have been formed as of those of the present day. A visit to a museum in which fossils are exhibited would astonish you with the multitude, variety, and beauty of those fossil creatures, and especially with the wonderful preservation of organisms the most delicate and frail.

Fossil Plants.—But the vegetable kingdom is as fully represented in the rocks as the animal. We find trees of the most varied kinds, with their roots, stems, branches, leaves, flowers, and fruit. We can look

with wonder on the exquisite carving on the stems of mighty trunks, hundreds of feet in height, that once formed forests as dense and impenetrable as those of the Amazon. But more, we can behold the trees standing on the very places in which they grew and waved their great branches, and can trace their roots as they penetrate the soil beneath. We can also gather plants of all kinds—reeds, mosses, rushes, seaweeds, and beautiful ferns—preserved entire, and spread out on the rock as delicate and perfect as in the finest herbarium. These fossil plants have, like the fossil animals, been examined and classified by botanists, and we possess elaborate volumes on the botany of the remote ages when these plants grew, similar to those on the existing flora of our globe.

Traces of Natural Operations.—But the rocks bear traces of more than all this. On them, we can see the very dints of the raindrops of these bygone ages, and can calculate the direction and force of the showers that impressed them. We can walk over the rippled sands of the old seas, just as we can do over those we played on in childhood. We can also look on the footprints of primeval birds, as they stalked in the mud of their lake or river homes; or gaze with astonishment on the great footprints, as large as a man's hand, of the huge reptiles that waddled among the reeds by the great old rivers. We can look into the craters of extinct volcanoes, can follow the flow of the destructive lava, and can gather the ashes that once illuminated the darkened heavens. We can trace the sources of ancient rivers, and dig in the mud brought down from their mountain sources; can draw maps of the continents and seas as they existed thousands of ages past; can tell where great ocean-currents flowed, bearing huge icebergs, that grated the sea-bottom, and left their indelible traces on the granite and trap of our present hills; and can shew where mighty glaciers once existed in valleys famed for their beauty, where now the genial sun sheds its warmest rays. In short, every element in nature, whether of air, river, or ocean, has left its deepest traces on the solid crust of our wonderful globe.

Agencies in the Formation of Rocks.

We now proceed to inquire into the manner in which rocks have been formed. Any explanation must account for *all* the phenomena, equally of composition, structure, arrangement, and contents. We must, for instance, explain how some rocks are stratified, and others not; how some are horizontal, and others inclined; and how plants and animals have come to be embedded in them so far below the surface. Are there, therefore, any agencies engaged in the formation of rocks at the present time that produce effects the same in kind with these older masses? If we find

that such exist, we shall have a key by which to interpret the rock-formations of the past. Let us consider, therefore, the Rock-forming Agents.

Volcanic Agents.—The most obvious rock-formers at present in action are volcanoes. From circular openings, called *craters*[1] from their *cup-like* shape, at the summits of these mountains, there issue forth at certain times great streams of molten lava, boiling water, red-hot fragments of rock, mingled with flames, and smoke, and steam, amidst confused and thundering sounds, and the general convulsion of the surrounding country. These lava-streams, increased by ashes and other substances, are often of great thickness, sufficient to bury cities; as Vesuvius once did Herculaneum and Pompeii, and Etna did Catania at its base, where the river of lava gradually rose round the walls, finally drowning the city in its burning flood, after it had flowed twenty-four miles! Successive accumulations of such outbursts deposit immense masses of rock, in the course of ages, round the centre of eruption; so great, indeed, that the larger portion of such mountains—and some of those in America are five miles in height—are formed of the successive accumulations of the crater itself. The molten lava assumes various appearances after it has lost its heat: under water, it remains hard and compact; in the open air, it becomes porous and cindery; and in certain cases, it assumes a columnar form. All around, lie light pumice-stone, slag-like masses, fine pulverised dust, and huge calcined blocks. Now, the Unstratified rocks resemble in every feature these volcanic discharges. We meet with the compact lava in our trap and greenstone; with the cinder, in the lighter porous rocks; with the ash, in our trap-tuffs; and with the columnar, in the basalt. In exposed sections, we see the very channel through which these masses burst and overflowed the strata above; and can trace the boundaries of the ancient molten streams in the cliffs and hills that everywhere vary the surface of the country. We can also see hardening and crystallising changes produced on the surrounding strata, wherever the heat of the erupted matter penetrated. We have therefore found the explanation of one great class of the rock-formations, the Unstratified, in the volcanoes scattered over the globe, that are at this moment depositing masses identical in kind with those that issued from the bowels of the earth in bygone ages. Such rocks, therefore, are termed *igneous*,[2] from being produced by *fire; volcanic*, from having issued from *volcanoes;* and *eruptive*, from being produced by *eruptions.*

Aqueous Agents.—Rivers, as they flow over their channels, gather accumulations of mud, sand, gravel, and animal and vegetable remains, according to the size of the stream and the character of the country through which they pass; and these they deposit at their mouths in seas or lakes. Sometimes the amount of débris thus deposited is

[1] Greek, 'a cup.'

[2] From Latin *ignis*, fire.

so great as to form large tracts of land, as at the protruding mouths of the Ganges, Nile, or Mississippi. Even in historic times, the land thus gained is of great extent. For example, at the mouth of the Po, a minor stream, the town Adria, which gave its name to the Adriatic Gulf from its extensive commerce in Roman times, in now nine miles from the sea! The mass of matter held in solution or borne along by the running water, sinks to the bottom when it reaches the sea, in a certain order. First the heavier masses are deposited, such as boulders and gravel; then, the sand; and last, the mud. Mingled with these are various animal and vegetable remains that have been washed into the stream. Thus, every river-mouth presents an ever-growing series of beds of varying thickness and material, superposed the one on the other, and enclosing various remains of animal and vegetable life. These strata would, in the above order, be converted, by pressure, into conglomerate, sandstone, slate, shale, and coal. Thus, again, we have found a beautiful and perfect explanation of the Stratified rocks as they are presented everywhere, by which their composition, stratification, and contents are fully accounted for. Stratified rocks, therefore, obtain the various names of *sedimentary*, because formed of the *sediment* of rivers; and *aqueous*,[1] because deposited under *water*.

Organic Agents.—But animal and vegetable life is also busy in the formation of rocks. Away in the warmer seas of the Pacific, lives the coral insect or zoophyte, the skeletons of which compose the remarkable coral reefs that form the chief part of the numerous isles that stud that greatest of seas. These reefs extend thousands of miles, in broad barriers, over which the wild waves dash, or in detached groups that gradually gather round them material and form new islands. In the rocks, we also find the remains of like corals, standing where they grew, or drifted away, and appearing as extensive formations of limestone.

Again, the bottom of the sea is covered with accumulations of minute shell-fish, of great depth and over extensive areas, as is proved every day by soundings with the lead. Now, the old rocks exhibit strata of identical composition with these microscopic shells; some limestones and chalks, for example, being composed of millions to the square inch of perfect bivalve shells. Again, the sea-bottom contains beds of shell-fish, of different kinds, and of great extent and thickness. Should these die, and then be subjected to sufficient pressure, they would form a rock, exactly like the shell limestones so common in our rock-formations, and so valuable in agriculture and building.

Then we have the remains of ancient forests in our great mosses; and luxuriant growths of swampy plants and impenetrable jungle in the mud islands of the deltas of our great rivers in the tropics. These,

[1] From Latin *aqua*, water.

submerged and acted on by heat and pressure for ages, would become coal, in every particular the same as that we daily use for fuel.

Thus, organic life of all kinds is everywhere busy in forming rock-masses, identical in character and appearance with those presented to our investigation in limestone, chalk, and coal.

Agencies in the Alteration of Rocks.

Rocks are changed from their original position, form, and structure by two classes of agents—those that disturb, and those that wear or disintegrate.

Disturbing Agents.—Stratified rocks in their natural state would be horizontal, or only slightly inclined. How, then, are we to account for the tiltings, upheavals, faults, and various dislocations so prevalent among the strata? The igneous forces, just spoken of, furnish the solution. The whole globe is subject to convulsive movements from the motion of the interior molten matter of the earth, which are seen in earthquakes, and by which the ground is torn into fissures, and the solid crust made to move in mighty undulations, that destroy and swallow great cities. Extensive tracts are also sometimes suddenly raised or depressed. Sometimes, too, great yawning craters open where previously volcanic movement was unknown, and continue for a time in active eruption. In these upheavals and subsidences, sudden or gradual, of extensive tracts, we see the causes at work of the dislocations of the rocks of former times, and of the elevations and depressions that occurred throughout the geologic eras.

Again, we know that in order to the deposition of strata of any thickness, the sea-bottom must have gradually subsided: does any such gradual subsidence take place at the present time? It is ascertained, from extended observations, that on the northern shores of the Baltic, for instance, there has been a gradual rise at the rate of 4 feet in a century, and in South America a rise of 85 feet during the human period, and at Valparaiso of 19 feet in 220 years; while over all the world, and even round our own coasts, ancient sea-beaches may be seen at various elevations, marking former sea-levels. On the other hand, the south coast of Sweden, the coast of Greenland over 600 miles, and parts of South America for the last 300 years, have been slowly sinking; nor are the British shores free from such oscillations.

Thus, again, we see that existing causes perfectly explain the *gradual* subsidences necessary to the formation of the rocks, and to their subsequent elevation into dry land.

Disintegrating Agents.—Every stratified rock in the immense thick-

ness of the crust of the globe has been formed of the débris of pre-existing formations, that have been ground down and held in solution till deposited in the layers afterwards hardened into rock. Whence, then, this immense accumulation of matter, and what the disintegrating agents?

1. *Atmospheric Agency.*—The atmosphere, by its chemical action, and by the combined effects of alternate heat and cold, wetness and dryness, is continually crumbling down all exposed surfaces, forming new soil, and thus increasing the earthy covering of the globe. The wind, also, has an incredible power of drifting and heaping up sandhills along the shore—as in the county of Elgin, where an ancient barony has been entirely reduced to a desert through this means—and in raising the waves of the sea, and wearing the rocks through the mighty force of its swooping billows. Frost, too, is one of the quietest but most powerful disintegrating agents; for when water has percolated a mass of rock, the act of freezing exerts a great expansive force which cracks the rock. But frost can work on a grander scale, for to its agency is due the existence of avalanches, glaciers, and icebergs; which, whether sweeping with overwhelming convulsion, or crawling down the mountain side, or floating and grating on the ocean floor, continually and with terrible effect, wear down or dash to pieces every rock that obstructs their irresistible course.

2. *Aqueous Agency.*—The most extensive aqueous agent is rain, which wears, softens, percolates, and gradually wastes away every rock on which it falls. The rain-water also gathers under the ground in large cavities, where springs are formed, which dissolve the interior rocks, and, bursting out, deposit their solutions of lime, iron, sulphur, soda, flint, and bitumen. One of the most powerful degrading agents is, of course, the sea; which, as it beats on its rocky shores, wears, rolls, and grinds to powdery sand the flintiest rocks, and presents as monuments of its mighty power of waste those lofty cliffs that guard its shores. But more powerful, but less obvious agents of destruction than the sea, are the many streams that everywhere traverse the land on their way to this boundless reservoir. The power of rivers in excavating and wearing away the surface of the globe is much greater than at first thought might be supposed. Every valley, however deep, has been mainly worn down by river-action, extending over immense periods of time. When we contemplate the mighty valleys enclosed by towering peaks capped with eternal snows, that lie hid amidst the mountain solitudes of the Alps, the Andes, or the Himalayas, we may well be astonished at such a statement. But that these huge excavations have been mainly produced by the combined action of air, frost, rain, and river, has been demonstrated beyond a doubt by a vast accumulation of facts and reasonings on phenomena in all parts

of the globe. Hence, valleys thus excavated are termed *valleys of erosion*,[1] from being ground out by the powerful action of these mighty agents. This being proved to be the case even during the human period, we are at no loss to account for the great denudation everywhere seen; and for the immense accumulations of sedimentary matter that form so much of the solid crust of our globe.

Transporting Agents.—We have finally to account for the deposition of strata in one part of the country, the materials for which have been obtained at great distances; and for the transport of immense boulders hundreds of miles from their original seats, as exhibited in all parts of the globe.

1. *Aqueous Agency.*—The most obvious agents of transport are rivers, that bear down from every part of their courses the débris deposited at their mouths. Their power of carrying masses of the heaviest materials is immense, as may be seen after a flood in the smallest streams in our neighbourhood. Waves have also a wonderful power of removing and carrying to a distance the blocks on which they daily dash. But the currents that flow through the ocean, which are but mighty ocean rivers, have the greatest influence in this respect. By their means, materials of all kinds, organic and inorganic, are conveyed to incredible distances. The Gulf-stream, for instance, conveys substances from the South African coasts to those of Norway and the far North.

2. *Ice Agency.*—But the transporting influence of these currents in bearing rock-masses is greatest when icebergs are carried on their surface. These huge frost-mountains have embedded in their mass the largest blocks, which are gradually dropped over wide areas as the ice slowly melts away. The size and number of some of these transported rocks are often almost incredible. Every country exhibits such travelled rocks, which are called *erratic boulders;* and our own little island presents no mean examples of such ice-borne masses.

But ice also acts as a transporter in the form of glaciers—those great ice-rivers that fill the upland valleys of the Alps, Himalayas, and such mountain systems. In front of every glacier, along its sides, and on its surface, are great collections of rocky fragments of every size, borne down by the ice-stream, and left as evidences of its existence when the glacier has melted away. Such collections of rocks are called *moraines*, from their *mural* or wall-like aspect as seen running across a valley. The distance to which such blocks are borne is astonishing, and depends on the size of the glacier. Evidences of extinct glaciers are seen in most countries, and we may trace their remains in our own island, where now not a particle of glacier ice can exist.

[1] From Latin *e*, out, away, and *rodo*, *rosum*, to gnaw.

3. *Igneous Agency.*—It is evident that volcanoes have a great power in throwing out masses of different materials to great distances, and of carrying many substances on their mighty lava-streams; and evidences of their power in this respect in geologic times are everywhere apparent. Sometimes the fine ashes that issue from the crater are borne by the wind to great distances, often fifty or a hundred miles, where they are deposited as a layer of finest dust; and this may account for the existence of trap-tuffs in places where no volcanic eruption seems to have taken place.

It thus appears that the agencies now at work on our own globe are adequately sufficient to account for all the phenomena of the forming, disturbing, disintegrating, elevating, depressing, and transporting of the rock-masses that form the crust of the earth. Such being abundantly proved, and the laws of nature being uniform and unchangeable, we are not only warranted, but compelled, to infer that the same influences were at work in these bygone ages, and were the joint causes of the formation of our rock-systems as they are now presented to our eyes and subjected to our investigation.

Examples of Geological Reasoning.

We shall now give some examples of the method of reasoning on the various phenomena presented in the rocks, the formation and history of which it is the province of Geology to unfold.

Reasoning regarding Rock Sections.

1. *Section with Igneous Action and Dislocation.*—From the section (fig. 81) let us see what we can discover, by the mutual relations of the rocks,

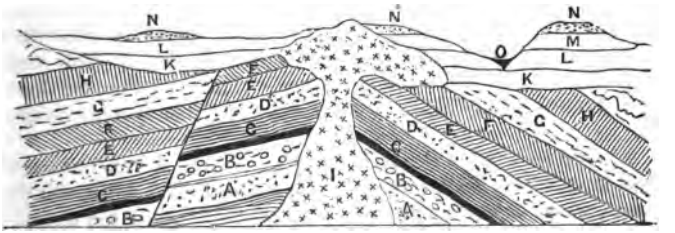


Fig. 81.

regarding the times of their formation and dislocation. Which rock was first deposited in this section? The lower rocks were of course formed

first, and the various strata were formed in the order of their superposition. You will observe that the strata marked from A to H are inclined, and, as these must have been deposited horizontally, they must therefore have been tilted up afterwards. We also see that the cause of their disturbance is the upheaval of the igneous mass I, which, issuing from beneath, has ruptured the strata previously flat, and overflowed part of the rocks where it rose to the surface. This upheaval has also thrown the strata at different angles, those to the right being more inclined than those to the left, and therefore forming a *fault*. We observe also that in the rocks to the left there occurs a great *slip*, for part stands at a different height from the rest. We can, however, easily trace each rock, as, for instance, the coal-seam C, from the one side of the section to the other through both slip and fault.

We also observe that after the trap eruption, the exposed rocks were subjected to long-continued water-action; for their outcrop is hollowed out into two valleys. After this period of denudation, the horizontal strata were deposited, and have not since been disturbed by volcanic action. We see also that a great part of the trap is covered by this new deposit, so that what was once a hill, before this new rock was laid down, is now almost hidden beneath the surface. The horizontal undisturbed rocks have, however, been much worn away by water-action; for deep valleys have been excavated in them, and the bed of a river still continuing the scooping out is seen at O. By looking at the highest and therefore last-formed deposit, we observe that it consists of gravel or silt. This, therefore, once formed the bottom of a lake or inland sea, where river-débris was deposited. This débris has been allowed to lie undisturbed till elevated above the sea-level, after which it has been worn down by streams. Patches of it still remain on the hill-tops over various parts of the surface, as at the points marked N.

2. *Section with Aqueous Action alone, without Dislocation.*—This second section (fig. 82) is of a part of the north coast of Norfolk, near the town of Cromer, and it is very striking and instructive. Let us see what we can learn from it regarding the history of the Norfolk shores. This section differs from the first in the entire absence of igneous action, for there is no displacement of any kind, its regularity being due to aqueous causes alone.

The lowest rock (A) is chalk, in which we can see represented regular rows of flints. This chalk consists of the remains of shell-fish and other creatures, whose organisms are found in the flints. After the deposition of the chalk, the land was raised, and a great forest grew over the chalky soil, which is well suited for the growth of trees. The roots of the old oaks, with part of their stems, are still seen erect as they grew!—embedded in the mud that accumulated round them when afterwards submerged.

But more remarkable still, at the time when these trees grew, huge elephants, rhinoceroses, and deer roamed over England, and strayed in the woods; as we know from their remains being found in this layer in many parts of the country! The forest afterwards sank under the waters of a

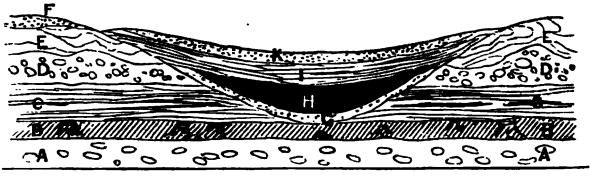


Fig. 82.

A, Chalk.
B, Forest bed, with elephant, rhinoceros, stag, &c., and tree roots and stumps.
C, Finely laminated clay, with shells.
D, Clay, with boulders, worn and scratched.
E, Contorted clay and gravel.
F, Gravel.
G, Coarse river-gravel.
H, Black peaty deposit, with shells, seeds, scales, and bones of pike, perch, and salmon.
I, Yellow sands.
K, Drifted gravel.

lake, and remained submerged for a long time, during which the thick deposit of clay was laid down, containing remains that lived in its waters. After the clay, a new agent acted upon the country. As will afterwards be shewn, the British Isles were subjected to the action of ice, the high mountains being covered with great glaciers, while icebergs floated over the submerged land, carrying boulders, and grinding down the surface of the land over which they passed. Here, away in Norfolk, we have the débris of what perhaps had been grated and rolled from the peaks of Wales and Cumberland! Then followed the deposition of the sand and gravel marked E and F. We observe, however, that F, though appearing on the left, has been washed away from the right side of the valley. After this gravel was laid down, a great river rolled its waters across the country, and wore away the strata, till it formed the deep valley that occupies the centre of the section. The gravel of this great river is still seen at the bottom of the hollow at G. Then followed a period when this valley formed the bed of an immense lake, into which flowed streams bearing the vegetable remains that now form the peat H. In this peat we find the scales and bones of the fish that gambolled in its waters—the perch, the salmon, and that fierce water-wolf, the pike. After this lake dried up, the sea flowed in, and the old river-valley became a bay or gulf, with its yellow sand I, and gravel K. These have subsequently been scooped out by streams, as shewn by the bend in the surface. We have, at last, reached the present time, when Norfolk was raised above the ocean, whose ancient bed is now trodden by the farmers and children of that fertile county.

Such are examples of the old-world stories disclosed by every rocky shore, railway-cutting, and river-cliff. We have been describing not what might have been, but what *was;* for we can prove every assertion, seeing that the rocks themselves furnish incontrovertible data.

Reasoning regarding Surface Phenomena.

1. *Iceberg Action.*—In some parts of Britain, as in the central region of Scotland, there are exhibited certain remarkable appearances from which striking deductions may be drawn. We find that all the hills, eminences, and rocks are precipitous towards the west, and exhibit traces of being rendered so by a mighty force wearing them down on that side. In the level ground between these heights we find a thick deposit of fine blue tenacious clay, with embedded stones, rounded and water-worn, which is known as boulder-clay. Also, laid down here and there, sometimes on mountain tops, we find enormous blocks brought from great distances to the west, as shewn by the rock of which they are made. We also discover all across the country certain remarkable scratchings, and deep indentations on the exposed surfaces of the hardest rocks, all pointing in one direction, at right angles to the broken cliffs. We also note that all heights are rounded and worn, as if ground down by some powerful agent moving over them.

The problem before us therefore is—How are all these appearances to be accounted for, and by what agent or agents were they produced?

It is evident, from the existence of the clay, that the whole region referred to must have lain under water. But water alone, even in a powerful current, could not carry the blocks, and make the deep scratches that everywhere are seen. It is evident that these effects must have been produced by something borne on the surface of the water, of size and hardness capable of doing all this. What hard substance, therefore, can be borne by water, that can carry rocks and leave deep scratchings behind it? Nothing but ice in the form of huge bergs; and a current bearing packs of these on its surface fully satisfies all the requirements of the case. Floating along, of enormous size, these ice-mountains wear down all surfaces over which they move; carry from great distances, and drop as they melt, blocks of every size; dash against and wear down into cliffs all opposing eminences; and leave marks on the rock-surfaces identical in appearance with those everywhere exhibited; while the current that bears them along, deposits in the lower grounds the mud and boulder débris they generate in their onward course. Thus we prove incontestibly that icebergs floated over the district exhibiting these phenomena. But was the climate such as to generate icebergs? This is proved, independently of the above reasoning, by various considerations; amongst others, by the fact, that in the boulder clay in various parts shells are found, called boreal

shells, that could only have lived in an arctic climate, and now live only in the northern seas.

2. *The Existence of Glaciers in Britain.*—In the same way, we can as conclusively prove that these great bergs were broken from glaciers that at that remote epoch filled the upper valleys of the Highlands, to the north and south. This is shewn by such facts as these, which we can but enumerate—the general aspect of these valleys; the striations and polished surfaces pointing always to the highest peaks, whence the ice-streams descended; the rounded rocks with steep sides looking *down* the valleys; the rocky, worn, and broken débris; the moraines or rock-walls driven before the advancing ice, or borne on its surface, and that now run along or across the valleys like ramparts; and other equally striking and conclusive phenomena. Thus we arrive at the undeniable fact, that the British Isles once exhibited in successive periods all the ice-features of Greenland, Norway, and the Alps.

The Rocks as Related to Time.

The Length of Geological Periods, or Geological Time.—In studying Geology, it is necessary to have an accurate notion regarding the nature of the periods spoken of. It is to be strictly observed that in Geology, time cannot be measured by years. When we examine any stratum of rock, with all its enclosed organisms, it is natural to inquire how long this mass of rock took to be deposited. We can judge of this only in the following way. From observation of river-action as at present exhibited, we see with what extreme slowness rock-masses are worn down into sand; how a thousand years make an almost imperceptible change on a boulder, and even on the gravel by the shore. Yet we know that the sandstone before us, often hundreds of feet in thickness, is composed of grains of rock ground down by water-action, transported by rivers to the sea-bottom, and deposited there till other strata were heaped upon it; and that in after-ages the grains united, and were hardened by pressure into the rock we see. What incalculable ages, therefore, must this sandstone bed have taken to be thus formed! The more we think of these slow-working causes, the more are we astonished at the enormous periods of time that must have elapsed before the formation of even the thinnest layer of rock. Geological periods, therefore, are quite indefinite in the matter of *years;* but from various considerations, we can arrive at certain very definite conceptions regarding the length of time required for the formation of the various rock-systems. This inability to assert a definite number of years in regard to any formation, is no defect in the science, for the knowledge of this would add not one item to the conception we

already have of the immense periods presented to our contemplation by geology.

The Relative Ages of Rocks.—When we speak of the ages of rocks, we can do so only by comparison with others. Our ideas on this point are merely relative. We can assert, as we have already done in analysing the rock-sections, that one layer must have been formed before another; or that, after its formation, and before the deposition of a certain other rock, a rise or fall in the strata took place; or that, at a certain point in the series, a volcanic eruption threw up a mass of igneous rock; and make like statements based on comparison of the rocks with one another. Our conceptions, therefore, regarding the connection in age between the various rock-formations are merely relative, one being proved to have taken place before, or after, or during the formation of another.

The Order of the Rock-formations.—By long-continued and widely extended observations in various parts of the globe, based on numberless data of composition, structure, inclination, and fossil contents, geologists have been able to form a definite list of the various rock-formations from the earliest to the most recent, arranged in the order of time. They have divided the whole of the rocks composing the crust of the earth into sections called 'systems,' and these again into 'groups,' in a certain well-defined order—so that when a rock is presented to their observation in any part of the globe, they can state, with more or less certainty, the system to which it belongs, and the period in the past history of the earth at which it was deposited. Regarding these rock-systems, one point is to be very strictly noted. Suppose that we represent the various rock-systems by the letters of the alphabet—the earliest by A, the second by B, and so onwards to the last and most recent, represented by Z. Now, the various rock-systems always stand in this relative historic order; so that the formation indicated by M is always after L, and before N, and cannot occur in any other relation to these two systems, wherever they may be found. At the same time, certain formations, one or more, may be awanting in certain parts of the world, not having been deposited there; so that one or more systems may not be represented in these districts. Thus, L and M may be awanting. What two systems will then be found together? Certainly and unvaryingly, K and N. But here the historic order is not violated, as it would be if N preceded K. The various rock-systems are, therefore, always presented in an unvarying succession in the order of their formation; although in different parts of the globe certain strata, and even whole systems, may not be found.

Classification of the Rocks—Description of the Rock-Systems.

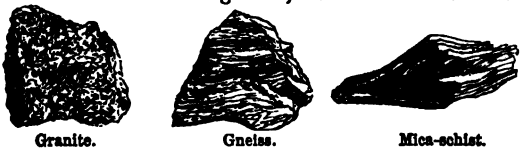
We now proceed to describe, in the order of their formation, the different kinds of rocks that compose the crust of the earth, and their fossil contents. As already said, geologists have divided all the rocks into different classes, according to their relative position and the fossils they contain. The whole of the rocks are divided into twelve great systems, and each of these into separate groups, to which names have been given, more or less descriptive of the strata to which they are applied. These systems we shall describe in order, beginning with the earliest, down to the most recent, giving the appearance and composition of the rocks, the uses to which they are applied, and the fossils they contain. We shall also endeavour to realise the state of the earth at each successive epoch, the scenery then exhibited, and the plants and animals that then enlivened the landscape. Before doing so, it is interesting to ask—

What Rock is oldest and lowest?—What rock is the foundation on which all others rest? On the answer to this question, geologists are not agreed. We know the oldest sedimentary rock; and though the above question were to remain unanswered, the science of geology proper would be as complete as it requires to be. But some approach can be made to an answer. Granite seems to underlie all other rocks; at least, as far as yet ascertained, no other rock has been found under the granite, and this rock is erupted through all other strata; but we cannot assert definitely that this is the primitive or oldest rock, but only that, as far as yet discovered, no other has been found to underlie it. All are familiar with this beautiful variegated rock as used for paving our streets, and as polished for gravestones and hewn into pillars. It has two chief varieties, the gray and the red, according to the prevailing mineral in its composition. It composes the mass of the chief mountain ranges, and forms part of some of the grandest scenes in nature. It is generally considered to be of igneous origin. It shews no stratification, occurs only in great mountain masses, or in veins intersecting other strata, and seems to point to a period in the past history of our globe when it was a great molten ball, with conditions that we can scarcely imagine, so different must they have been from those now existing. But it seems to be undeniable, that before any of the stratified rocks were deposited, and before any life existed, the globe was in a state of molten fusion through intense heat; and that we have before us, in the granite, the remains of that igneous condition, which now exists as a cold, crystallised, variegated rock, containing valuable minerals, and of great industrial value.

I.—Metamorphic System.

Description.—Immediately above the granite, and resting directly upon it, lie the most ancient sedimentary rocks in the long series of formations before the human era. These rocks do not exist now as they were laid down. The whole granite surface seems to have retained much of its heat, at least so much as to have changed the character of the mud at the bottom of the seas, and thus formed the hard crystalline rocks of this earliest sedimentary system. It is from being thus changed or *metamorphosed* by heat that they have received the name of the *Metamorphic System*.[1] They consist of various strata, of which the chief are Gneiss, Quartz-rock, Mica-schist, and Clay-slate.

Gneiss,[2] so named from its thin layers, is a hard crystalline rock, in extremely thin bands, often twisted in a remarkable manner. It consists mainly of the same minerals as granite, from which it was formed, but



Granite. Gneiss. Mica-schist.

Fig. 83.

these are broken and confused. Quartz-rock, as its name implies, is composed of fine grains of quartz. Mica-schist obtains its name from the particles of mica that form its chief ingredient. These three kinds of rocks compose one great group, and, though frequently intermingled, occur in the above order. They are extensively developed in Britain, especially in the Highlands of Scotland, where they form the mass of the mountain ranges, and enter into the grand and beautiful scenery of that picturesque region. With them also occurs limestone, which, having been crystallised by heat, forms beautiful marbles, quarried for various purposes.

Clay-slate is that most useful rock, which, split up into thin layers, forms the familiar blue slates for our roofs, and the slate and slate-pencil used every day in school. There is something very interesting in the thought, that the slates you may now see before you, or may be even now using, and the pencil in your hands, are obtained from the earliest of all our rock-formations, and are formed of the fine sand washed from the primitive granite, but lately cooled down!

Organic Remains.—The Metamorphic rocks, from being the earliest of our rock-systems, are known also as the *Primary* rocks, or those first

[1] From Greek *meta*, change, and *morphē*, form. [2] From Anglo-Saxon *gnidan*, to rub.

formed. Because they seem to contain no fossils, they have also been called the *Non-fossiliferous* rocks; but this assertion of the absence of organic remains is not to be taken as final, because in them fossils may yet be discovered, as they have been in the upper beds, which have lately been formed into an independent system. The existence also of plumbago in these rocks, the lead-like mineral used for pencils, which is a kind of coal, and may therefore have been formed of vegetable matter, seems to shew the likelihood of future organic discoveries.

Scenery.—Regarding the scenery of this early epoch, we can form only the dimmest conception. After the intense heat of the primitive granite had subsided, and the once molten mass seems to have become hard and solid as we now see it, a system of things appears to have begun, bearing more likeness to that now existing. Granite mountains reared their heads, great seas rolled their billows, while rivers flowed across the plains, conveying to the ocean-floor the débris of the granite continents. Such organic life as then existed, if it did exist at all, has either been totally destroyed by the great heat of the granite surface, or remains yet to be discovered.

II.—Laurentian System.

Description.—Immediately above the Non-fossiliferous Metamorphic rocks lie the lowest of those that contain fossils. These have received the name of the *Laurentian System*, from their great development on the shores of the St Lawrence, in Canada. It was only quite lately, in the year 1863, that these rocks were grouped into a distinct system, from the discovery in them of certain fossil remains in Canada, having previously been reckoned Metamorphic. The Laurentian System consists of certain schists, quartzose rocks, and limestones, all very highly crystallised—only little less so than the Metamorphic rocks. They contain no sandstones or shales, that occur so frequently in higher formations, such of these as once existed having been changed by heat. Even the limestone is unlike the limestones that occur higher up, being very highly crystallised. The rocks, however, are all truly sedimentary, deposited under water, and have received their present aspect mainly through the agency of heat. They are found in Canada, the Hebrides, Ireland, and Norway and Sweden.

Organic Remains.—The discovery of the fossil remains that caused these rocks to be formed into a separate system, was made in Canada, and excited interest amongst geologists, because belonging to a period when organic existence was thought impossible. The organism discovered received the name of the Canadian Eozöon[1] or *Dawn-animalcule*, and

[1] From Greek *ēōs*, dawn, *zōon*, an animal.

consists of minute tubes or cells that are visible only under the microscope. Some still deny that this structure is organic, and regard it as merely a mineral appearance; but these are few. The general opinion now is that here we have the earliest life-remains yet discovered on our globe; and this all the more certainly that worm tracks and burrows were found in 1866 in the same formation. The discovery of these evidences of organic life, so long sought in vain, shews that more minute search may result in other remarkable discoveries, and that in all likelihood the name of Eozöon will be found to be premature.

III.—Cambrian System.

Description.—Immediately above the Laurentian lies a series of slates, schists, and crystalline limestones, called the Cambrian System. It is so named from being first most fully described as it is found in North Wales, which in Roman times was called *Cambria*. The rocks in this series are less changed than the Laurentian, and therefore the remains in them are more numerous and better preserved. They are of great thickness, and are found in Wales, Cumberland, North-west Scotland, Ireland, North America, and elsewhere. Along with the older rocks beneath them, they everywhere form mighty rugged peaked mountains, like those of Wales and the Highlands; and their worn rugged aspect is due to their being so long subjected to wasting influences from their great antiquity. All these earlier rock-formations, from the Metamorphic to the Silurian, are exceedingly rich in mineral wealth, most of the precious metals being obtained from them. Shooting through their hard crystalline masses, we find veins of iron, copper, silver, and gold; and, from the presence of these metals, bare mountain tracts have teeming populations, where even the sheep with difficulty finds its scanty food.

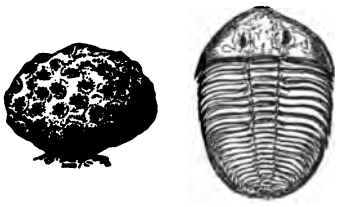
Organic Remains.—The fossil remains are all of the very lowest kinds of life. Sea-weeds, shells of different kinds, and some crustacea, especially one that occurs abundantly in the next formation, called the trilobite, have been discovered. The tracks and burrows of worms, formed in the sand of the ancient seas, may also be seen perforating these hard masses.

Scenery of Period.—During the Cambrian age, quiet seas heaved their waters as now, tenanted with shells and crab-like creatures, while waves rolled on the sandy shores, over which worms crawled, and into which they burrowed; interesting as shewing that creatures had then the same kinds of habits as now, and that what we can see any day along our own shores sends us back to the distant ages when the world was young!

IV.—Silurian System.

Description.—The Silurian System contains rocks less changed by heat than those below, and exhibiting more abundant life. In those already mentioned, the change that has passed over the strata has been so great as to render it difficult to say, with certainty, how the rocks were originally formed, but henceforth all hesitation vanishes. We have slaty sandstone finely laminated, and often exhibiting ripple-marks; conglomerates chiefly of rounded pebbles, clays, and limestones, with corals and other fossil remains, all of great thickness. The system has received the name of Silurian from being very fully developed in a part of South Wales anciently called *Siluria*, and is therefore named from its chief locality. From these rocks are obtained roofing-slates, freestone for building, flagstones for paving and other purposes, limestones, from which lime is got by burning, and valuable ores of lead, copper, silver, mercury, and gold.

Organic Remains.—Parts of the stems and leaves of water-plants and club-mosses, and a few sea-weeds, are found, but all scarce and much broken. No land *animals* have yet been obtained, and though it would be rash to say that they do not exist, everything seems to render this very probable. But marine fossils are numerous and well marked, some of them being very beautiful. We find corals of different kinds, named according to their appearance, such as the sun, star, cup, pipe, chain, spider, and honeycomb corals. One of the commonest forms in the Silurian rocks is a very beautiful curved creature like the plume of a goose-quill, called the *Graptolite*,[1] from looking like a *pen* on the *rock*; some single, others double, some straight, others beautifully spiral. Another very abundant form is the Encrinite, a coral creature more numerous in the Carboniferous System. We find also star-fishes, and numerous shells with single and double valves, some like the periwinkle and cockle being abundant. But the creature that swarmed most in the ancient Silurian seas was the *Trilobite*, so called from its body consisting of *three lobes* or divisions, above which was set its head with large double eyes, still to be found entire. It had various forms, and seems to have been very active, and



Coral. Trilobite.

Fig. 84.—Silurian Fossils.

[1] From *grapho*, I write, and *lithos*, a stone.

was of all sizes, from mere specks to fine specimens ten or twelve feet long. Creatures like the scorpion, with toothed toes, are also obtained, and in the upper beds fishes.

Scenery of Period.—Of the dry land we know little or nothing, except that it did exist, and nourished certain aquatic plants and club-mosses, whose remains were floated down into the great seas. But we can see mighty oceans, in which corals flourished, and encrinites waved their lily stems. Shells were abundant, and numerous creatures gambolled in the bright sun. These seas were fringed by sandy shores, on which worms crawled and left their tracks; gravelly beaches, that have become conglomerates; and great beds of shells, that have given origin to thick limestones. Life gradually assumes more activity, and living forms become more numerous and elevated in the scale of existence as we ascend in the system towards the active period that follows.

V.—Devonian System.

Description.—The Devonian System of rocks has been rendered famous through the writings of several geologists, especially the celebrated Hugh Miller, and is one that in itself possesses the very greatest interest. In early geology, the Coal-measures were considered very important; and as both below and above them a great thickness of red sandstone is found, the rocks above were named the *New Red Sandstone;* while those below, being of course older, were called the *Old Red Sandstone*, or, shortly, the *Old Red.* As these older rocks are extensively developed in Devonshire, this system has also been called the *Devonian* System, a name now more used than the other. These rocks are found also in other parts of Britain, especially in Forfarshire and Caithness, where they are extensively quarried, and in parts all over the world. The name 'Old Red' indicates that the chief rock is a red sandstone, which is used very extensively for building. This also occurs in fine flags used for pavement, generally of a gray colour—the famous Arbroath and Caithness pavements being from this system. The remarkable rock called Conglomerate or 'Plum-pudding Stone,' which looks as if it consisted of a consolidated sea-beach, is also found extensively in this system.

Organic Remains.—There are comparatively few plants found in the Old Red, as compared with the animal remains. We find sea-weeds of different kinds, marsh-plants like our bulrushes, sedges and horsetails, tree-ferns and reeds; but they are neither abundant nor well preserved. Animal remains are numerous, varied, and beautiful. There are many species of corals and shells. The tracks of certain creatures, and deep burrows, sometimes eighteen inches deep and one and a half across, made by large burrowing worms, are frequently found. Many crustaceans are

obtained, one of which is a huge kind of crab, sometimes six feet long, with terrible-looking toothed claws, called the *Pterygotus*[1] or ear-wing. Reptiles are also found, two very large lizards being most frequent.

But by far the most numerous specimens of ancient life are gigantic fishes. These creatures are all covered with hard bony scales, burnished with enamel, with fierce teeth, and great fins armed with long sharp spines, with which they defended themselves or attacked their enemies.

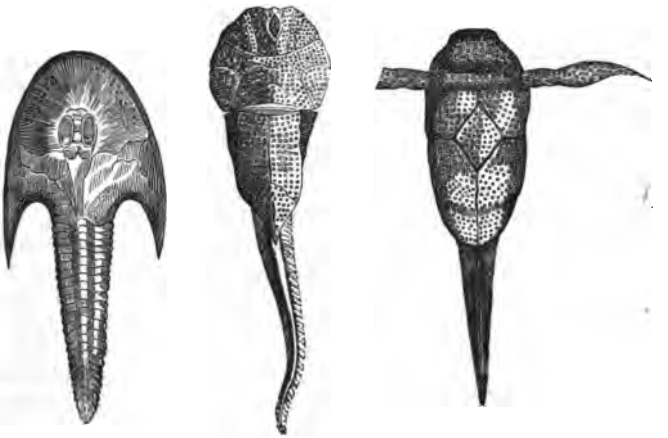


Fig. 85.—Old Red Sandstone Fishes.

These fishes have received different names, according to peculiarities in their structure or appearance, and have been brilliantly described by Hugh Miller, who, when cutting the Old Red Sandstone as a mason, had his attention first drawn to geology by the brilliancy of their scaly armour.

Scenery of Period.—The wide oceans in which the thin fine-grained flags were deposited must have been smooth and tranquil. Round the coral islands that rose in its gleaming waters coursed huge fierce fishes. The sandy shores became the coarser sandstone. Within tide-mark, numerous great crabs lived, and caught their prey in their toothed claws; shrimp-like creatures danced over the sands, and in them worms burrowed; the waves ebbed and flowed, leaving their ripple-marks on the rocks we now see; gravel beaches fringed the shore, where the surges rounded the pebbles and rolled the stones, creating our conglomerates;

[1] *Pteron*, a wing, and *ous*, *otos*, the ear.

and rain-showers fell over the land, and left there the sandy bays pelted with their drops; and forests of sea-weed waved in the green waters and on the rocky reaches; and shells adorned the rocks. Into the seas flowed great rivers, whose banks were fringed with reeds and flags; ferns waved on the hill-side, tree-ferns reared aloft their feathery plumes, and broad-leaved plants clothed the surface of the landscape; while large reptiles roamed through the forests, or crushed the reeds by the river-sides.

VI.—Carboniferous System.

Description.—Above the Devonian rocks lies a series of strata perhaps more generally known than any other, as they afford us what is so necessary to our comfort, the remarkable combustible stone called coal. They receive the name Carboniferous from the fact that they contain coal, although they furnish many other important products. These rocks are found in most regions of the globe; but in none are they more fully developed, compared with the size of the country, than in the British Isles. They consist of sandstones, limestones, shales, clays, ironstone, and coal. The sandstone is of various qualities and colours, some of it very valuable and durable; the beautiful stone of which the New Town of Edinburgh is built being from this system. The limestones are largely developed, and are of the greatest service for building and agriculture. The shales have of late become very valuable, as from them are distilled oils and other substances, including the celebrated paraffin oil and candles. The ironstone is of the very greatest value.

It must not be thought that coal is found only in the Carboniferous rocks. Coal being simply compressed vegetable matter, may be found in any rock-system in which plants are preserved, and is so found in other systems, and often in great abundance. For example, the coal-fields of Virginia, some thirty or forty feet thick, belong to another system, the Oolitic; and coal of various kinds can be obtained, more or less, from most systems.

The same is true of other products, such as limestone, sandstone, and iron, which last, though found in greatest abundance in this system, yet occurs in many others.

The Coal-strata are divided into three great groups—the Upper and Lower Measures, and a thick deposit of limestone, which separates them, known as the Mountain or Carboniferous Limestone. The Upper Coal-measures are also called the True Coal-measures, as they contain the greatest amount of workable coal; the Lower Coal-measures consist chiefly of sandstones and shales. The Mountain Limestone is so called because where it is most largely developed, as in Yorkshire, it rises into hills with great limestone cliffs.

The industrial products of this system are numerous and important. We have coal of all kinds for household purposes and gas; iron, sandstone, limestone, and fire-clay. From the shales are obtained alum and the remarkable paraffin oil; and so abundant in America and elsewhere is

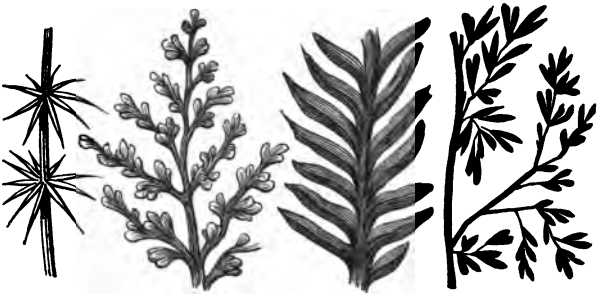


Fig. 86.—Carboniferous Plants.

this ancient oil, that when the earth is bored, a flood of it issues forth yielding thousands of gallons daily.

Organic Remains.—The organic remains found in this system are very abundant and remarkable. Plants are numerous, varied, and beautiful.

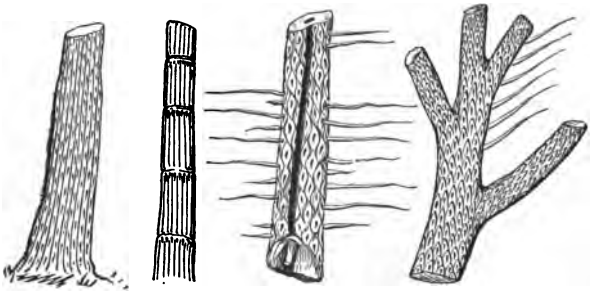


Fig. 87.—Carboniferous Trees:
1, Sigillaria; 2, Calamite; 3, Stigmaria; 4, Lepidodendron.

Ferns are found with the most perfect fronds, as distinctly traced upon the rock as a modern dried fern on the pages of a book. We find also large and beautiful club-mosses exquisitely exhibited. But the most luxuriant and beautiful of all are the great pine-like araucarias, the tree-ferns, and tall reeds that grew in boundless swamps and jungles along

the banks of the rivers that swept in mighty volume to the carboniferous sea. We see the lepidodendron[1] or scale-tree, with its pine-like leaves, beautiful scaly bark, and great cones, from which the seed of the ancient pine may be gathered in hundreds to this very day; the sigillaria[2] or seal-tree, with its seal-stamped trunk and great pitted and branched roots, long thought to be a tree of a different species; calamite[3] or reed, rising high into the air, like the bamboo, with its joints and leafy branchlets; and many more, equally beautiful and well preserved.

The animal remains found are numerous and strange. Corals are abundant and beautiful; but no sea-creature was more common than the encrinite, which rose on its long jointed stalk, bearing its cup-shaped body, with its hundred fingers, that moved on all sides to secure its prey, like the anemone of our own seas. The remains of encrinites are in some places so abundant as to form thick beds of limestone, called Encrinital Limestone; and when these, hard as marble, are polished, they present a most beautiful surface, through which is seen the exquisite carving of the encrinite stars. The little joints of the stems are often found detached, with a hole through the centre; these are known as Fairy Beads and as St Cuthbert's Beads; and when strung together, were used as a rosary, and no more beautiful ornament was ever hung round the neck of a saint. We also find star-fishes and sea-urchins; and the spines of the latter may be seen running through the limestone like threads of burnished silver. The shells are very numerous and varied; univalves and bivalves of both sea and land being everywhere found, and some of these can hardly be distinguished from shells gathered on our own shores, so perfect are they in form, colour, and structure. They may be detached from the rock, and collections made of them as easily as of modern shells. We find also crustaceans of different kinds; and the last trilobites are found in the Coal-measures. Fishes are numerous and formidable, but less so than in the Old Red Period. Reptiles in both salt and fresh water have also

Fig. 88.—Fragment of Encrinital Limestone.

[1] From Latin *lepis*, a scale, and *dendron*, a tree.
[2] From Latin *sigilla*, a seal.
[3] From Latin *calamus*, a reed.

left their remains, and their footprints may be seen on certain sandstones as distinct as if made but yesterday on the soft mud.

Scenery of the Period.—In this remarkable period there stretched wide shallow seas, in which sported huge sharks, and whose waters washed the shores of many islands, guarded by great coral reefs, where the beautiful encrinite spread its waving arms. By the shores lived numerous shells, often in immense beds, that now form the mussel-band of the miner; and into these seas flowed Amazonian rivers, bearing into the deep the spoils of their wooded and reedy shores. By their wide estuaries and along their banks lay extensive impassable swamps and jungles, in which gigantic reeds, calamites, and tree-ferns flourished in tropical luxuriance, and amidst these lurked fierce crocodiles and mighty lizards, which have left their footprints on the yielding mud. The whole surface of the land was covered with tall pines and tree-ferns; the seal-palm, the scale-tree, and star-leaf shot into the air in impenetrable thickets, shaking their numerous cones in the breeze, while the hum of insects might be heard in their still recesses. In the distance might be seen towering snow-peaks, and here and there the smoke of the volcano, the existence of which was felt in the numerous earthquakes that shook the ground.

VII.—Permian System.

Description.—Immediately above the Carboniferous strata, we find certain strata that used to be called, as already explained, the *New Red Sandstone*, in contrast with the rocks below them, called the Old Red Sandstone. This New Red Sandstone series has been of late more thoroughly examined, and found to consist of two distinct portions, whose remains are so different that the series has been formed into two distinct systems, known as *Permian* and *Triassic*. The name Permian has been given to the system we now describe, from being developed very extensively in Perm, a province in the north-east of Russia. These rocks are found in many parts of the world, and largely in Scotland, England, Germany, and Russia. They consist of red and whitish sandstones, shales, and limestones, containing much magnesia. The rocks are remarkably variegated in colour, so much so as to be called the Variegated System; while the limestone receives the distinctive name of the Magnesian Limestone. As the old name suggests, the sandstone is of a reddish hue, and the two chief rocks, therefore, are the Red Sandstone and the Magnesian Limestone. The sandstones are used for building, as are also the limestones, which have been employed in the construction of the Houses of Parliament. Copper is also extensively obtained from one of its shales in Germany, and also lead and zinc, but not very abundantly.

Organic Remains.—The plants resemble greatly those of the Coal-

measures. We find sea-weed, fine-leaved ferns, tall calamites, and reeds, great pines with cones, tree-ferns, and palms like the modern fan palm. The animal remains are not nearly so numerous as in the coal rocks. There are sponges, corals, sea-urchins, and beautiful shells. We also find fishes like those of the Coal-measures, and the Permian is remarkable as the system where the ancient form of tail, in which the spine of the fish was continued into the upper lobe of the tail, becomes extinct, never to appear again. The reptiles of this system are numerous and perfectly developed, some of them being of gigantic form. Their footprints, in particular, are remarkably abundant and large, and from these alone, the whole animal has been constructed by learned men, the truth of their drawings being proved by subsequent discovery of the entire creature. Even pouched animals, like the kangaroo, are found in the American Permian, thus shewing a gradual but slow approach to modern life forms.

Scenery of Period.—The Carboniferous Period was remarkable for the great activity of volcanic agents, but this period seems to have been comparatively tranquil in this respect. The rivers carried in their waters much iron, as they did in the Old Red Period; the seas appear to have been shallow, bearing in solution magnesia and salt, while animal and vegetable life seems scarce, as compared with other epochs. From the existence of a rough conglomerate in the west of England, it has been ably argued that the greater part of the period was one of glacial action, with icebergs bearing blocks and rounded *débris;* and if this was the case, we have a conclusive explanation of the scarcity of life during this period.

VIII.—Triassic System.

Description.—The upper part of the old system, known as the New Red Sandstone, has received the name *Triassic*, which means *triple*, from being found in Germany in three distinct groups, of which the first and third alone exist in Britain.

The system contains sandstones of different colours, shales, and conglomerates; but the distinguishing product is rock-salt. This occurs in beds of from seventy to one hundred feet thick in Cheshire, whence we obtain salt for daily consumption. Salt-springs also abound in salt districts, being formed by the issuing of water through the salt rocks below. The Triassic rocks are found in patches in the British Isles, but extensively on the continent of Europe and in America.

Organic Remains.—The organic remains are very scanty, especially when compared with the exuberance of life in eras before and after. Plants are rare both in number and species. We find horse-tails, calamites, and ferns. The gigantic trees of the Coal-measures no longer exist,

and we have instead short palm-like trees, like the modern cycas. The vegetation is mostly of a tropical kind.

Animals are far from abundant, but are more numerous than the plants. We have no corals, few encrinites, and bone-plated fishes are rare. There are a few shells, some crustaceans, and several great shark-like fishes. Reptiles, however, are numerous and of gigantic size. One brute in particular, called the *Labyrinthodon*, from the *labyrinth*-like structure of a section of its *teeth*, is an uncouth, frog-like creature, with great staring eyes, and immense toothed jaws. The most abundant remains in the Triassic are the great footprints of large lizards. These are found in Scotland, but are so numerous in America, that above one hundred species of creatures have been distinguished, as indicated by these footprints. Huge birds, too, were numerous, and have also left their marks

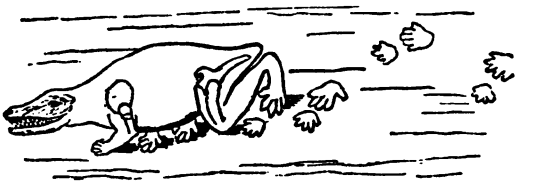


Fig. 89.—Labyrinthodon.

upon the rocks. These rocks furnish the earliest evidences of warm-blooded mammals.

Scenery.—The scenery of the old Triassic age is peculiar, and we can form but a dim notion regarding it. We can easily see that the seas were shallow with bordering lagoons, in which the salt waters were evaporated in the strong sun-rays, and left the salt-beds that are now of such service to us. By the muddy rivers lived great crocodiles, that lurked amid the reeds and pines, and fed on shell-fish and crustaceans, and left their footprints on the yielding mud, while on the dry plains above grew plants adapted for an arid soil and tropical climate.

IX.—Oolitic System.

Description.—We have now arrived at a remarkable epoch, whose remains, abundant and wonderful, have been more fully investigated and described by celebrated men than perhaps any other. We begin also a new epoch in geologic history; the forms of life, habits, and scenery are more like those of our own times, and can therefore be restored with the greater certainty.

The term *Oolitic* is applied to a series of rocks which in England form three distinct groups—the Lias, Oolite Proper, and Wealden.

The Lias is the oldest, and receives its name, a corruption of *liers* or *layers*, from the thin variegated beds of which the rocks are composed, and which present a remarkable ribbon-like appearance not easily forgotten. The Oolite[1] is above the Lias, and is so called from the rock being greatly composed of small round grains like the eggs of the cod, so that it signifies the *egg-rock*, being called also *roestone* and *peastone*, according to the size of the particles. These strange granules consist almost entirely of lime or grains of sand coated with lime. The *Wealden* is the highest rock in the series, and receives its name from being developed largely in the *Weald* in Kent and Sussex. The name *Oolitic* has been applied to the whole system, because the egg-structure is common to all the rocks in the series, although the term *Jurassic*, from its being largely found in Mount Jura, is given to it by some geologists.

The Oolitic system consists of a series of sandstones, limestones, sometimes so hard as to be used as marble, shales, and clays, while ironstone bands, coal, lignite, and jet are abundant. The sandstones are useful as building-stone, the celebrated Bath and Portland stones, so much used in

Fig. 90.—Oolitic Plants:
1, Palm; 2, Tree-fern; 3, Cycas; 4, Pandanus; 5, Zamia.

London and the south of England, being varieties. The limestones are burned for agricultural purposes; the clays are extensively developed, and receive different names in different parts, and yield alum, sulphur, and fuller's-earth. Ironstone is abundant and good, and furnishes a great part of the iron of Yorkshire, being eleven feet thick. The coal is

[1] From Greek *ōon*, an egg, and *lithos*, a stone.

workable and abundant, which disproves the notion too prevalent that coal can be obtained only from the Coal-measures. Lignite is a less hard variety of coal, and the jet, which is only a crystallised coal, yields the beautiful jet of Whitby, so much used for ornaments.

Organic Remains.—The remains of plants and animals are so abundant, that their enumeration and description would fill volumes, and we can merely roughly indicate some of their wonderful forms.

Vegetable life was abundant, requiring a warm climate like that of Australia. We find sea-weeds, beautiful tree-ferns, lily-like leaves, palms like the pandanus, and pines like the araucaria and yew. The clays that occur were the very soil on which those ancient forests grew, and in some of them, known as 'dirt-beds,' the roots are seen in natural position, with part of the trunk broken over, while the tree itself lies close by, as if cut down by the woodman but yesterday.

The animal remains are abundant and remarkable. We find sponges, exquisite star-corals, beautiful encrinites, sea-urchins, worms, and lobsters. The shells are very beautiful and varied, the most remarkable being the ammonite, of which there are one hundred and thirty species, and the nautilus. Gigantic cuttle-fish floated and spread their black ink through the oolitic seas. Fishes were numerous and large; huge plated sharks devoured their prey, their very names telling terrible things, such as 'Strong-tooth,' 'Sharp-tooth,' and 'Great-jaw:' tortoises also floated on the summer seas.

Fig. 91.—Ammonite.

But the most striking remains are those of reptiles, so numerous, strange, and uncouth, that the Oolite has been designated the 'Age of Reptiles.' We find enormous skeletons, some of them thirty feet long, of large lizards and crocodiles, all being more or less strange and terrible.

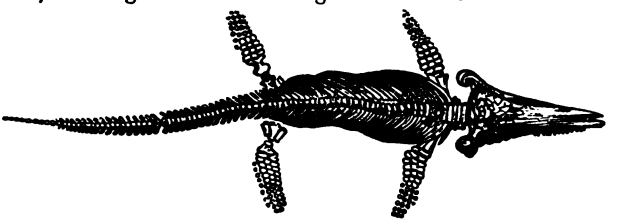


Fig. 92.—Skeleton of the Ichthyosaurus.

In these rocks, too, a most interesting discovery has lately been made, that of the earliest feathered creature—a real bird—in which the bones,

claws, and full-spread plumage are finely seen. The remains of the earliest warm-blooded animals have also been found—a kind of pouched creature like the kangaroo.

Scenery.—The scenery and animals of the Oolitic Period resemble, to a remarkable extent, those of Australia, both in vegetable and animal remains. The land and water went through many changes during this long period. In the Lias times, the seas were deep and tranquil; under the Oolite, exposed coral beaches were dashed by great breakers, that have left their work in broken shells and marls; while the Wealden seems to have been the carried deposits laid down in the estuary of a mighty river, that rolled into the sea in what is now the south of England; and the present icy lands of the arctic regions were covered with the vegetation of a warm climate, which now appears as Oolitic coal strata.

X.—Chalk or Cretaceous System.

Immediately above the Oolite lies a system in which the chief rock is the well-known substance chalk, and which has hence received the name of the *Chalk*, or, what is the same thing, *Cretaceous*[1] System. In this system, other rocks also occur, chalk-marl or blue-clay, known by the local name of *Gault* or *Golt;* thick beds of green-coloured sand, called *Greensand;* and, embedded in the chalk, nodules of flint, which when less pure is called *Chert;* and coal, in Vancouver's Island. The chalk is used for many purposes: when it is burned, it forms a useful lime; when hard enough, is used for building-stone; and when crystallised, forms a fine white marble. The flints are an important ingredient in china, porcelain, and glass, and from the sands we obtain fuller's-earth. The whole system has been generally divided into two groups, the lower being called the Greensand, and the upper the Chalk.

Organic Remains.—The plant-remains are rare and imperfect, and seem to have been all drifted. Leaves of different kinds, palms, fruits, cones, and bits of pines have been discovered. Animal remains, however, are very numerous, and most beautifully preserved. We find sponges, corals, sea-urchins, complete in form and structure, beautiful star-fish, numerous crustaceans, and varieties of the lobster tribe. The shells are plentiful, and exquisitely beautiful in form and even in colouring, and are the finest fossil preservations found in any system—including splendid ammonites and nautiluses, and hundreds of other species, whose mere names would fill pages. Fishes are not numerous, but are well preserved, and, as in other systems, are named from peculiarities in form or structure, such as the 'twisted tooth,' the 'wrinkle tooth,' 'thick tooth,' and such

[1] From Latin *creta*, chalk.

like. Reptiles are also found similar to those in the Wealden. Bones of birds have been discovered, as also bones of what seems to be a species of monkey.

Scenery.—The Chalk series appears to be wholly a marine deposit. The land we know little or nothing of; sufficient, however, to shew that it was clothed with vegetable life, as in other periods, but little to picture its appearance. Over it, huge Wealden reptiles sought their prey, birds flew, and great apes swung from tree to tree. But the ocean swarmed with varied life, mild sea-breezes blew, and smiling sunbeams sparkled upon its waters; for the climate was warm, as shewn by the corals, reptiles, and monkeys. In the tepid waters lived numberless fishes and shells, and on their surface the nautilus spread its coloured sail.

The origin of chalk is a problem not yet satisfactorily settled, but the generally received opinion is, that the shores were fringed by coral reefs, which the dashing waves gradually wore down into fine powder, as they still do in tropical seas, while millions of shell-fish teemed in its waters, and left their white shells as an impalpable sand, that, under the microscope, shews the tiny houses of the old inhabitants as perfect as on the day they died. Flint seems mostly to consist of concretions round sponges, corals, and other substances, and may be found at any epoch, and occurs in many other formations besides the Chalk, though there in greatest abundance.

XI.—Tertiary System.

We have now arrived at a new epoch in the history of the rocks, known as the Epoch of Recent Life. Henceforward, the plants and animals bear not only a close resemblance to those now existing, but a great proportion of them are identical. We discover real exogenous trees, the same corals, crustaceans, and shells, equal-lobed fishes, birds, and mammals of existing families—and all these not only more numerous than hitherto, but also more perfectly preserved. The name given to this system is a relic of the names used in early geology, when all rocks were divided into Primary, Secondary, and Tertiary. In the Tertiary System, two great periods are easily distinguishable: 1. The *Warm Period;* 2. The *Cold Period.*

1. The Warm Tertiary Period.—This system exhibits clays, sands loose or hard, gypsum or plaster of Paris, and marls. The only true rock is limestone, made up of innumerable little shells, so numerous that the stone, which is extensively found throughout the world, is named from its *coin*-like shells, nummulitic.[1] The limestone is burned for various purposes; the clays are extensively used; the harder sands are employed for

[1] From Latin *nummus*, a coin.

building; and amber is also found. The strata occur exclusively in patches known as *basins*, the London and Paris basins being the most important.

Fossil Remains.—The remains are both numerous and important. Of plants, there are few marine specimens, as these were too tender to be preserved. We find, however, mosses, palms, ferns, leaves, fruits, seeds of different kinds, and whole pods of pea-plants. We have real exogenous timber, with specimens of fine palm, cypress, and fir.

The animals resemble or are identical with existing species, and the Tertiary System has been divided into periods according to the percentage of life-remains. We have corals, star-fish of the same species as those existing, and the shells are very beautiful, finely preserved, and scarcely distinguishable from those to be gathered on our present shores.

Among the fishes, we find various species of the shark, ray, sturgeon, sword-fish; and of fresh-water kinds, the perch and the carp. Among the reptiles there are the crocodile and alligator, and the turtle. Birds are numerous, one specimen found in the Paris basin being gigantic. Mammals are found of every existing order, amongst others the whale, elk, stag, antelope, camel, lama, tapir, hog, rhinoceros, hippopotamus, beaver, hare, squirrel, monkey, elephant, horse, tiger, and hundreds of others. So numerous are these remains in some parts, that one rock in Norfolk is known as the *Mammaliferous Crag*. But the most remarkable of the ancient animals are the huge monsters whose skeletons, carefully reconstructed, may be seen in the British Museum, some of them above 10 feet high, and 20 feet long. The most wonderful is the mammoth, with two great tusks like an elephant. Others are the dinotherium[1] or 'fierce wild beast,' the megatherium[2] or 'great wild beast,' and the mastodon. In different parts of the world, and in many places in England, remarkable caves are found filled with bones of various animals in clay or sands, known as 'bone-caves.' These caves have some of them been the dens of savage tigers and other brutes, the bones of their prey being still found; some the abodes of different creatures at different times who have lived and died there; while others have had their contents washed into them by floods.

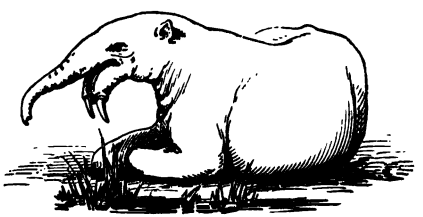


Fig. 93.—Dinotherium.

Scenery.—During this period shallow seas rolled under a genial sun, in

[1] From Greek *deinos*, terrible, and *thērion*, beast.
[2] From Greek *megas*, great, and *thērion*, beast.

which low islands rose crowned with palms, while the savage shark and sword-fish swam in the surrounding waters; the elephant ranged through the tall groves on shore; the hippopotamus wallowed in the fresh-water lakes; the rhinoceros crashed through rank jungles; the mastodon, mammoth, and tapir trod in forests of palm; and the wild ox and buffalo roamed over wide grassy prairies.

2. The Cold Tertiary Period.—Immediately above the strata just described, with these strange organisms that speak of a warm climate, are found remarkable accumulations of sand, often found pure in hillocks; gravel, and clay interspersed with rounded worn boulders, known under

Fig. 94.—Megatherium.

the general title of the 'Boulder Clay,' some of the boulders being of enormous size. From various phenomena, as shewn in a former chapter, it has been proved that the climate became arctic in character, and our country and others enveloped from shore to shore in a vast ice-sheet, like the Greenland of to-day. From the ends of this huge ice mantle, immense masses broke off and floated away as icebergs. By and by, however, the

climate became milder, and Britain looked like Norway and Iceland, with glaciers on the higher grounds, reaching here and there to the sea. Gradually the great ice-fields melted away under the rays of the genial sun, and our country looked like the present Switzerland, till at length the last glacier disappeared from the highest hills. The effects of all the wear and movement of these ice-masses, whether grinding down the land or grating on the floor of the ocean, or dashing against opposing islands, are seen in the thick clay and sand deposits everywhere around us, enclosing worn stones and gravel; the scratched and rounded rock-surfaces often bright and smooth as polished marble; the 'erratic boulders,' perched on our hill-tops and plains; and the general wavy outline of all higher ground throughout our land. This glaciation has been ascertained to extend over the whole of Northern Europe and America, and round the shores of the Antarctic Ocean.

XII.—Quaternary or Recent Period.

We have now reached the last of the great geological epochs, during which sea and land, plants and animals, have remained little changed from what they are now. This last system has been variously named the *Post Tertiary*, *Quaternary*, or *Recent*.

The whole system may be divided into two chief periods:

1. *The Prehistoric*, or that before history was written.
2. *The Historic*, or that since history was written.

During the whole epoch, there is little or no solid rock, the whole deposits consisting of clay, sand, gravel, mud, peat, and the like.

Of *prehistoric* deposits, we find such remains as these: plants of all kinds, all common shells and corals, and common animals, with a few now extinct, such as the long-fronted ox, the gigantic Irish deer—a creature ten feet high to the top of its horns—the elephant, rhinoceros, hyena, bear, and mammoth, besides human remains in bones, canoes, ashes, dwellings, and weapons.

In *historical* times, we find similar remains, but the deposits are comparatively small; and the plant and animal remains are almost solely those now existing in each country. Men have left traces of themselves in buildings, coins, implements, weapons, and works of art; while peat-bogs have been formed, forests have been submerged or cut down, and considerable changes in sea-level have taken place.

Since the glacial epoch, a continuous series of changes has been going on without intermission, accomplished by various causes and in various ways. The land has changed its level several times both by elevation and depression, the sea thus alternately encroaching on and retiring from the land. Whole countries have been gained from the ocean, such as the Fens

in England and the greater part of Holland; old beaches may be distinctly traced, with their cliffs, shores, and shells far above sea-level; whole forests have been submerged, whose old trunks and fruits are thrown up by every storm; and huge accumulations of sand, blown or washed, have been found along its shores. Rivers have been depositing new matter under the ocean at their mouths, increasing the land by the formation of deltas, sometimes hundreds of miles in extent, laying down fine carse-land along their banks, that now forms the richest soil of the farmer, and leaving terraces far above their present level, to mark their former beds. Many lakes have been formed, others are gradually silting up from the earthy matter brought down by rivers, while some have become quite dry and are now waving with corn. Animals have been busy forming new islands and continents, as in the Pacific, where the coral insect leaves its skeleton to form the nucleus of future islands; birds have deposited guano; and myriads of microscopic creatures cover the floor of the ocean, some of the earths now existing being so full of these as to be used by savage tribes as food; and igneous agencies have been and are as active as in the olden times in changing the land and throwing out vast deposits of lava and ashes.

Man.—It is an interesting question how far back man extends into these geologic eras, and this important inquiry has of late years received great attention. Striking results have also been arrived at. It seems to be indisputably proved that man existed as far back as the great glacial period, at the close of the Tertiary epoch, and that he was contemporary with the hairy rhinoceros, mammoth, woolly elephants, and other gigantic creatures now long extinct, which he no doubt hunted as he now does the fox and the deer; and at a period when Britain was united to France, where now the sea flows in the Straits of Dover, his bones have been found in the same deposits with these animals. But this subject is but in its infancy, and it would therefore be unwise to make positive statements where our data are insufficient. Enough has, however, been discovered to shew that men have lived with strange denizens for many ages, and under very different conditions, in our own quiet land.

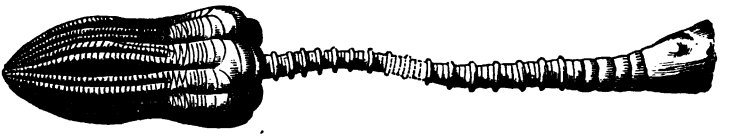


Fig. 95.—Encrinite.

ROCK FORMATIONS.

No.	Systems.	Reason of Name.	Characteristic Rocks.	Characteristic Life.	Great Periods.	
I.	METAMORPHIC.	From *change* in strata.	Slate and gneiss.	Non-fossiliferous.	Hypozoic or Lifeless Period.	
II.	LAURENTIAN.	From being developed on the *St Lawrence.*	Eozöon limestone.	Canadian Eozöon.	Palæozoic or Ancient Life Period.	Palæozoic or Great Ancient Life Cycle.
III.	CAMBRIAN.	From being developed in *Cambria* or N. Wales.	Slaty rocks.	Lower crustaceans.		
IV.	SILURIAN.	From being developed in *Siluria* in S. Wales.	Slaty rocks with rich ores.	Corals and shells.		
V.	DEVONIAN.	From being developed in *Devon.*	Old red sandstone.	Plated fishes.		
VI.	CARBONIFEROUS.	From containing *coal.*	Coal and iron.	Exuberant vegetation.		
VII.	PERMIAN.	From being developed in *Perm* in Russia.	New red sandstone and limestone.	Last unequally-lobed fishes.		
VIII.	TRIASSIC.	From consisting of *three* groups.	Salt.	Tropical—great foot-prints.	Mesozoic or Middle Life Period.	Neozoic or Great New Life Cycle.
IX.	OOLITIC.	From *egg*-grained *rocks.*	Egg-grained rocks.	Huge reptiles.		
X.	CRETACEOUS.	From containing *chalk.*	Chalk.	Chiefly marine.		
XI.	TERTIARY.	From being the *third* of the old geologic systems.	Clay.	Most existing species.	Cainozoic or Recent Life Period.	
XII.	RECENT.	From being *recently* formed.	Peat.	Man and existing animals.		

Geological Map of the British Isles.

Geology compared to History.

'Geology is intimately related to almost all the physical sciences, as history is to the moral. A historian should, if possible, be at once profoundly acquainted with ethics, politics, jurisprudence, the military art, theology; in a word, with all branches of knowledge by which any insight into human affairs, or into the moral and intellectual nature of man, can be obtained. It would be no less desirable that a geologist should be well versed in chemistry, natural philosophy, mineralogy, zoology, comparative anatomy, botany; in short, in every science relating to organic and inorganic nature. With these accomplishments, the historian and geologist would rarely fail to draw correct philosophical conclusions from the various monuments transmitted to them of former occurrences. They would know to what combination of causes analogous effects were referrible, and they would often be enabled to supply, by inference, information concerning many events unrecorded in the defective archives of former ages. But as such extensive acquisitions are scarcely within the reach of any individual, it is necessary that men who have devoted their lives to different departments should unite their efforts; and as the historian receives assistance from the antiquary, and from those who have cultivated different branches of moral and political science, so the geologist should avail himself of the aid of many naturalists, and particularly of those who have studied the fossil remains of lost species of animals and plants.

'The analogy, however, of the monuments consulted in geology, and those available in history, extends no further than to one class of historical monuments—those which may be said to be *undesignedly* commemorative of former events. The canoes, for example, and stone hatchets found in our peat-bogs, afford an insight into the rude arts and manners of the earliest inhabitants of our island; the buried coin fixes the date of the reign of some Roman emperor; the ancient encampment indicates the districts once occupied by invading armies, and the former method of constructing military defences; the Egyptian mummies throw light on the art of embalming, the rites of sepulture, or the average stature of the human race in ancient Egypt. This class of memorials yields to no other in authenticity, but it constitutes a small part only of the resources on which the historian relies, whereas in geology it forms the only kind of evidence which is at our command. For this reason we must not expect to obtain a full and connected account of any series of events beyond the reach of history. But the testimony of geological monuments, if frequently imperfect, possesses at least the advantage of being free from all suspicion of misrepresentation. We may be deceived in the inferences which we draw, in the same manner as we often mistake the nature and import of phenomena observed in the daily course of nature, but our liability to err is confined to the interpretation, and, if this be correct, our information is certain.'—Sir Charles Lyell.

SELECTIONS FROM THE POETS.

CHRONOLOGICALLY ARRANGED.

Edmund Spenser: 1553—1598.

From THE FAERIE QUEEN.

Encounter between the Redcross Knight and Sansloy.

They had not ridden far, when they might see
  One *pricking* towards them with hastie heat, *riding*
  Full strongly armd, and on a courser free
  That through his fiersnesse fomed all with sweat,
  And the sharpe yron did for anger eat,
  When his hot ryder spurd his *chauffed* side: *heated*
  His looke was sterne, and seemed still to threat
  Cruell revenge, which he in hart did hyde;
And on his shield *Sansloy* in bloody lines was dyde.

When nigh he drew unto this gentle payre,
  And saw the Red-crosse which the knight did beare,
  He burnt in fire; and *gan eftsoones* prepare *began soon after to*
  Himselfe to batteill with his couched speare.
  Loth was that other, and did faint through feare,
  To taste th' untryed dint of deadly steele:
  But yet his Lady did so well him cheare,
  That hope of new good hap he gan to feele;
So bent his speare, and spurd his horse with yron heele.

But that proud *Paynim* forward came so ferce *pagan, infidel*
  And full of wrath, that, with his sharphead speare,
  Through vainly crossed shield he quite did perce;
  And, had his staggering steed not shronke for feare,
  Through shield and body *eke* he should him beare: *also*
  Yet, so great was the *puissance* of his push, *power, force*
  That from his sadle quite he did him beare.
  He, tombling rudely downe, to ground did rush,
And from his gored wound a well of bloud did gush.

Dismounting lightly from his loftie steed,
He to him lept, in minde to *reave* his life, *take away*
And proudly said: 'Lo! there the worthie meed
Of him that slew Sansloy with bloody knife:
Henceforth his ghost, freed from repining strife,
In peace may *passen* over Lethe[1] lake; *pass*
When mourning altars, purgd with enimies life,
The black infernall Furies[2] *doen aslake;* *do slake or mitigate*
Life from Sansloy thou tookst, Sansloy shall from thee take.'

The Seasons.

So forth issew'd the Seasons of the yeare:
First, lusty Spring all *dight* in leaves of flowres *adorned*
That freshly budded and new bloosmes did beare,
In which a thousand birds had built their bowres,
That sweetly sung to call forth paramours;
And in his hand a javelin he did beare,
And on his head (as fit for warlike *stoures*) *encounters*
A *guilt* engraven *morion* he did weare; *gilded, helmet*
That as some did him love, so others did him feare.

Then came the jolly Sommer, being dight
In a thin silken cassock coloured greene,
That was unlyned all, to be more light:
And on his head a girlond well beseene
He wore, from which, as he had *chauffed* been, *heated*
The sweat did drop; and in his hand he bore
A bowe and shaftes, as he in forrest greene
Had hunted late the *libbard* or the bore, *leopard*
And now would bathe his limbes with labor heated sore.

Then came the Autumne all in yellow clad,
As though he joyed in his plentious store,
Laden with fruits that made him laugh, full glad
That he had banisht hunger, which to-fore
Had by the belly oft him pinched sore:
Upon his head a wreath, that was enrold
With ears of corne of every sort, he bore;
And in his hand a sickle he did holde,
To reape the ripened fruits the which the earth had *yold.* *yielded*

Lastly, came Winter cloathed all in frize,
Chattering his teeth for cold that did him chill;
Whilst on his hoary beard his breath did freese,
And the dull drops, that from his purpled *bill* *nose*
As from a *limbeck* did adown distill: *still*
In his right hand a tipped staffe he held,
With which his feeble steps he stayed still;
For he was faint with cold, and weak with *eld;* *old age*
That scarse his loosed limbes he hable was to *weld.* *move*

[1] *Lethe*, a river of the infernal regions, the water of which, when drunk, produced forgetfulness of the past.
[2] *Furies*, the three mythological goddesses of vengeance.

Christopher Marlowe: 1563—1593.

The Shepherd to his Love.

Come live with me, and be my love,
And we will all the pleasures prove
That valleys, groves, or hills, or field,
Or woods, and steepy mountains yield.

Where we will sit upon the rocks,
And see the shepherds feed our flocks,
By shallow rivers, to whose falls
Melodious birds sing madrigals.

And I will make thee beds of roses,
And then a thousand fragrant posies,
A cap of flowers, and a kirtle
Embroidered all with leaves of myrtle;

A gown made of the finest wool,
Which from our pretty lambs we pull;
Slippers lined choicely for the cold,
With buckles of the purest gold;

A belt of straw and ivy-buds,
With coral clasps and amber studs:
And if these pleasures may thee move,
Come live with me, and be my love.

The shepherd swains shall dance and sing,
For thy delight, each May morning:
If these delights thy mind may move,
Then live with me, and be my love.

Michael Drayton: 1563—1631.

Summer's Eve.

Clear had the day been from the dawn,
All chequered was the sky,
Thin clouds, like scarfs of cobweb lawn,
Veiled heaven's most glorious eye.

The wind had no more strength than this,
That leisurely it blew,
To make one leaf the next to kiss,
That closely by it grew.

The rills that on the pebbles played
Might now be heard at will;
This world they only music made,
Else everything was still.

The flowers, like brave embroidered girls,
Looked as they much desired
To see whose head with orient pearls
Most curiously was *tyred*. *dressed*

And to itself the subtile air
Such sovereignty assumes,
That it received too large a share
From nature's rich perfumes.

Sir Walter Raleigh: 1552—1618.

From 'The Pilgrimage.'

Give me my scallop-shell of quiet,
My staff of faith to walk upon;
My scrip of joy, immortal diet;
My bottle of salvation;
My gown of glory, hope's true gauge,
And thus I'll take my pilgrimage!
Blood must be my body's 'balmer,
No other balm will there be given;
Whilst my soul, like quiet palmer,
Travelleth towards the land of Heaven;
Over the silver mountains
Where spring the nectar fountains.

Lines composed the Night before his Execution.

When such is time, that takes on trust
Our youth, our joys, our all we have,
And pays us but with earth and dust;
Who in the dark and silent grave—
When we have wandered all our ways—
Shuts up the story of our days:
But from this earth, this grave, this dust,
My God shall raise me up, I trust!

Richard Barnfield: ? 1570—?

As it fell upon a day,
In the merry month of May,
Sitting in a pleasant shade,
Which a grove of myrtles made;
Beasts did leap, and birds did sing,
Trees did grow, and plants did spring;
Everything did banish moan,
Save the nightingale alone.
She, poor bird, as all forlorn,
Leaned her breast up-till a thorn;
And there sung the dolefull'st ditty,
That to hear it was great pity.
Fie, fie, fie, now would she cry;
Teru, teru, by and by;
That, to hear her so complain,
Scarce I could from tears refrain;
For her griefs, so lively shown,
Made me think upon mine own.
Ah!—thought I—thou mourn'st in vain;
None takes pity on thy pain:
Senseless trees, they cannot hear thee;
Ruthless bears, they will not cheer thee:
King Pandion[1] he is dead;
All thy friends are lapped in lead;
All thy fellow-birds do sing,
Careless of thy sorrowing!

[1] Pandion, king of Attica, was the father of Philomela, who was changed into a nightingale.

William Shakspeare: 1564–1616.

Scene from 'Coriolanus.'—Rome. A Street.

Enter a company of mutinous Citizens, *with staves, clubs, and other weapons.*

1*st Cit.* Before we proceed any further, hear me speak.

All. Speak, speak.

1*st Cit.* You are all resolved rather to die than to famish?

All. Resolved, resolved.

1*st Cit.* First, you know, Caius Marcius is chief enemy to the people.

All. We know 't, we know 't.

1*st Cit.* Let us kill him, and we 'll have corn at our own price. Is 't a verdict?

All. No more talking on 't: let it be done: away, away!

2*d Cit.* One word, good citizens.

1*st Cit.* We are accounted poor citizens; the patricians, good.[1] What authority surfeits on would relieve us. If they would yield us but the superfluity, while it were wholesome, we might guess they relieved us humanely; but they think we are too dear: the leanness that afflicts us, the object of our misery, is as an inventory to particularise their abundance; our sufferance is a gain to them.—Let us revenge this with our pikes, ere we become rakes:[2] for the gods know, I speak this in hunger for bread, not in thirst for revenge.

2*d Cit.* Would you proceed especially against Caius Marcius?

All. Against him first: he 's a very dog to the commonalty.

2*d Cit.* Consider you what services he has done for his country?

1*st Cit.* Very well; and could be content to give him good report for 't, but that he pays himself with being proud.

2*d Cit.* Nay, but speak not maliciously.

1*st Cit.* I say unto you, what he hath done famously he did it to that end; though soft-conscienced men can be content to say it was for his country, he did it to please his mother, and to be partly proud; which he is, even to the altitude of his virtue.

2*d Cit.* What he cannot help in his nature you account a vice in him. You must in no way say he is covetous.

1*st Cit.* If I must not, I need not be barren of accusations; he hath faults, with surplus, to tire in repetition. [*Shouts within.*] What shouts are these? The other side o' the city is risen: why stay we prating here? to the Capitol!

All. Come, come.

1*st Cit.* Soft! who comes here?

2*d Cit.* Worthy Menenius Agrippa; one that hath always loved the people.

1*st Cit.* He 's one honest enough: would all the rest were so!

Enter Menenius Agrippa.

Men. What work 's, my countrymen, in hand? Where go you with bats and clubs? The matter? Speak, I pray you.

1*st Cit.* Our business is not unknown to the senate; they have had inkling, this fortnight, what we intend to do, which now we 'll shew 'em in deeds. They say poor suitors have strong breaths; they shall know we have strong arms too.

Men. Why, masters, my good friends, mine honest neighbours,
Will you undo yourselves?

1*st Cit.* We cannot, sir, we are undone already.

Men. I tell you, friends, most charitable care

[1] Used here in a commercial sense.
[2] An allusion to the old proverb, 'As lean as a rake.'

Have the patricians of you. For your wants,
Your suffering in this dearth, you may as well
Strike at the heaven with your staves as lift them
Against the Roman state; whose course will on
The way it takes, cracking ten thousand curbs
Of more strong link asunder than can ever
Appear in your impediment: for the dearth,
The gods, not the patricians, make it; and
Your knees to them, not arms, must help. Alack,
You are transported by calamity
Thither where more attends you; and you slander
The helms o' the state, who care for you like fathers,
When you curse them as enemies.

1st Cit. Care for us!—True, indeed!—They ne'er cared for us yet. Suffer us to famish, and their storehouses crammed with grain; make edicts for usury, to support usurers; repeal daily any wholesome act established against the rich; and provide more piercing statutes daily, to chain up and restrain the poor. If the wars eat us not up, they will; and there 's all the love they bear us.

Men. Either you must
Confess yourselves wondrous malicious,
Or be accus'd of folly. I shall tell you
A pretty tale; it may be you have heard it;
But, since it serves my purpose, I will venture
To stale 't a little more.

1st Cit. Well, I 'll hear it, sir: yet you must not think to *fob off* *put off*
our disgrace with a tale: but, an 't please you, deliver.

Men. There was a time when all the body's members
Rebell'd against the belly; thus accus'd it:—
That only like a gulf it did remain
I' the midst o' the body, idle and unactive,
Still cupboarding the viand, never bearing
Like labour with the rest; where the other instruments
Did see and hear, devise, instruct, walk, feel,
And mutually participate; did minister
Unto the appetite and affection common
Of the whole body. The belly answer'd—

1st Cit. Well, sir, what answer made the belly?

Men. Sir, I shall tell you.—With a kind of smile,
Which ne'er came from the lungs, but even thus
(For, look you, I may make the belly smile
As well as speak), it tauntingly replied
To the discontented members, the mutinous parts
That envied his receipt; even so most fitly
As you malign our senators, for that
They are not such as you.

1st Cit. Your belly's answer? What!
The kingly-crowned head, the vigilant eye,
The counsellor heart, the arm our soldier,
Our steed the leg, the tongue our trumpeter,
With other muniments and petty helps
In this our fabric, if that they—

Men. What then?—
'Fore me, this fellow speaks!—what then? what then?

1st Cit. Should by the cormorant belly be restrain'd,
Who is the sink o' the body—

Men. Well, what then?
1*st Cit.* The former agents, if they did complain,
What could the belly answer?
Men. I will tell you;
If you 'll bestow a small (of what you have little)
Patience a while, you 'll hear the belly's answer.
1*st Cit.* You are long about it.
Men. Note me this, good friend;
Your most grave belly was deliberate,
Not rash like his accusers, and thus answer'd.
'True is it, my incorporate friends,' quoth he,
'That I receive the general food at first,
Which you do live upon; and fit it is,
Because I am the storehouse and the shop
Of the whole body: but if you do remember,
I send it through the rivers of your blood,
Even to the court, the heart, to the seat o' the brain;
And, through the cranks and offices of man,
The strongest nerves, and small inferior veins,
From me receive that natural competency
Whereby they live: and though that all at once,
You, my good friends,' this says the belly, mark me—
1*st Cit.* Ay, sir; well, well.
Men. 'Though all at once cannot
See what I do deliver out to each;
Yet I can make my audit up, that all
From me do back receive the flour of all,
And leave me but the bran.' What say you to 't?
1*st Cit.* It was an answer: how apply you this?
Men. The senators of Rome are this good belly,
And you the mutinous members: for examine
Their counsels and their cares; digest things rightly,
Touching the weal o' the common; you shall find,
No public benefit which you receive
But it proceeds, or comes, from them to you,
And no way from yourselves.—What do you think?
You, the great toe of this assembly?—
1*st Cit.* I the great toe? Why the great toe?
Men. For that, being one o' the lowest, basest, poorest,
Of this most wise rebellion, thou go'st foremost:
Thou rascal, that art worst in blood to run,
Lead'st first, to win some vantage.—
But make you ready your stiff bats and clubs;
Rome and her rats are at the point of battle,
The one side must have *bale.*—Hail, noble Marcius! rain

Enter CAIUS MARCIUS.

Mar. Thanks.—What 's the matter, you dissentious rogues?
1*st Cit.* We have ever your good word.
Mar. He that will give good words to thee will flatter
Beneath abhorring.—What would you have, you curs,
That like nor peace nor war? the one affrights you,
The other makes you proud. He that trusts to you,
Where he should find you lions finds you hares;

Where foxes, geese: you are no surer, no,
Than is the coal of fire upon the ice,
Or hailstone in the sun. Your virtue is,
To make him worthy whose offence subdues him,
And curse that justice did it. Who deserves greatness
Deserves your hate: and your affections are
A sick man's appetite, who desires most that
Which would increase his evil. He that depends
Upon your favours swims with fins of lead,
And hews down oaks with rushes. Hang ye! Trust ye!
With every minute you do change a mind;
And call him noble that was now your hate,
Him vile that was your garland. What 's the matter,
That in these several places of the city
You cry against the noble senate, who,
Under the gods, keep you in awe, which else
Would feed on one another?—What 's their seeking?

Men. For corn at their own rates; whereof, they say,
The city is well stor'd.

Mar. Hang 'em! They say!
They 'll sit by the fire, and presume to know
What 's done i' the Capitol; who 's like to rise,
Who thrives, and who declines; side factions, and give out
Conjectural marriages; making parties strong,
And feebling such as stand not in their liking
Below their cobbled shoes. They say there 's grain enough!
Would the nobility lay aside their *ruth*, *pity*
And let me use my sword, I 'd make a quarry
With thousands of these quarter'd slaves, as high
As I could *pick* my lance. *pitch*

Men. Nay, these are almost thoroughly persuaded;
For though abundantly they lack discretion,
Yet are they passing cowardly. But, I beseech you,
What says the other troop?

Mar. They are dissolved: hang 'em!
They said they were an-hungry; sigh'd forth proverbs—
That hunger broke stone walls, that dogs must eat,
That meat was made for mouths, that the gods sent not
Corn for the rich men only:—with these shreds
They vented their complainings; which being answer'd,
And a petition granted them, a strange one
(To break the heart of generosity,
And make bold power look pale), they threw their caps
As they would hang them on the horns o' the moon,
Shouting their emulation.

Men. What is granted them?

Mar. Five tribunes to defend their vulgar wisdoms,
Of their own choice: one 's Junius Brutus,
Sicinius Velutus, and I know not—*'Sdeath!* *God's death!*
The rabble should have first unroof'd the city,
Ere so prevail'd with me; it will in time
Win upon power, and throw forth greater themes
For insurrection's arguing.

Men. This is strange.

Mar. Go, get you home, you fragments!

Scene from 'King Lear.'—The Country near Dover.

Enter GLOSTER, *and* EDGAR *dressed like a peasant.*

Glo. When shall we come to the top of that same hill?
Edg. You do climb up it now: look how we labour.
Glo. Methinks, the ground is even.
Edg. Horrible steep:
Hark, do you hear the sea?
Glo. No, truly.
Edg. Why, then your other senses grow imperfect
By your eyes' anguish.
Glo. So may it be, indeed:
Methinks thy voice is alter'd; and thou speak'st
In better phrase and matter than thou didst.
Edg. You are much deceiv'd; in nothing am I chang'd,
But in my garments.
Glo. Methinks, you are better spoken.
Edg. Come on, sir; here's the place!—stand still.—How fearful
And dizzy 'tis, to cast one's eyes so low!
The crows and choughs, that wing the midway air,
Shew scarce so *gross* as beetles: half-way down *large*
Hangs one that gathers samphire—dreadful trade!
Methinks he seems no bigger than his head:
The fishermen, that walk upon the beach,
Appear like mice: and yon tall anchoring bark,
Diminish'd to her *cock;* her cock, a buoy *cock-boat*
Almost too small for sight: the murmuring surge,
That on the unnumber'd idle pebbles chafes,
Cannot be heard so high.—I'll look no more;
Lest my brain turn, and the deficient sight
Topple down headlong.
Glo. Set me where you stand.
Edg. Give me your hand: you are now within a foot
Of the extreme verge: for all beneath the moon
Would I not leap upright.
Glo. Let go my hand.
Here, friend, is another purse; in it, a jewel
Well worth a poor man's taking: fairies, and gods,
Prosper it with thee! Go thou further off;
Bid me farewell, and let me hear thee going.
Edg. Now fare you well, good sir.
[*Seems to go.*
Glo. With all my heart.
Edg. Why I do trifle thus with his despair
Is done to cure it.
Glo. O you mighty gods!
This world I do renounce; and, in your sights,
Shake patiently my great affliction off:
If I could bear it longer, and not fall
To quarrel with your great opposeless wills,
My snuff and loathed part of nature should
Burn itself out. If Edgar live, O, bless him!—
Now, fellow, fare thee well.
Edg. Gone, sir. Farewell.—
[GLOSTER *leaps, and falls along.*

And yet I know not how conceit may rob
The treasury of life, when life itself
Yields to the theft: had he been where he thought,
By this had thought been past.—Alive or dead?
Ho, you sir! friend!—Hear you, sir!—speak!
Thus might he pass indeed:—yet he revives:
What are you, sir?
Glo. Away, and let me die.
Edg. Hadst thou been aught but gossamer, feathers, air,
So many fathom down precipitating,
Thou hadst shiver'd like an egg: but thou dost breathe;
Hast heavy substance; bleed'st not; speak'st; art sound.
Ten masts at each[1] make not the altitude
Which thou hast perpendicularly fell;
Thy life 's a miracle. Speak yet again.
Glo. But have I fallen, or no?
Edg. From the dread summit of this chalky bourn:
Look up a-height;—the *shrill-gorg'd* lark so far *shrill-throated*
Cannot be seen or heard: do but look up.
Glo. Alack, I have no eyes.—
Is wretchedness depriv'd that benefit,
To end itself by death? 'Twas yet some comfort,
When misery could beguile the tyrant's rage,
And frustrate his proud will.
Edg. Give me your arm:
Up:—so.—How is 't? Feel you your legs? You stand.
Glo. Too well, too well.
Edg. This is above all strangeness:
Upon the crown o' the cliff, what thing was that
Which parted from you?
Glo. A poor unfortunate beggar.
Edg. As I stood here below, methought his eyes
Were two full moons; he had a thousand noses,
Horns whelk'd, and wav'd like the enridged sea;
It was some fiend: therefore, thou happy father,
Think that the clearest gods, who make them honours
Of men's impossibilities, have preserv'd thee.
Glo. I do remember now: henceforth I 'll bear
Affliction, till it do cry out itself,
'Enough, enough,' and die. That thing you speak of,
I took it for a man; often 'twould say,
'The fiend, the fiend:' he led me to that place.

Description of Night in a Camp.—From 'King Henry V.'

From camp to camp, through the foul womb of night,
The hum of either army stilly sounds,
That the fix'd sentinels almost receive
The secret whispers of each other's watch:
Fire answers fire; and through their *paly* flames *pale*
Each battle[2] sees the other's umber'd[3] face:

[1] *At each* is supposed to be a misprint. Various corrections have been proposed, as *attach'd; on end; at length; at least.*
[2] Body of troops; an obsolete usage.
[3] Darkened as if with umber—an iron ore of a dark-brown colour.

Steed threatens steed, in high and boastful neighs
Piercing the night's dull ear; and from the tents,
The armourers, accomplishing the knights,
With busy hammers closing rivets up,
Give dreadful note of preparation.
The country cocks do crow, the clocks do toll,
And the third hour of drowsy morning name.
Proud of their numbers, and secure in soul,
The confident and over-lusty French
Do the low-rated English play at dice;
And chide the cripple tardy-gaited night,
Who, like a foul and ugly witch, doth limp
So tediously away. The poor condemned English,
Like sacrifices, by their watchful fires
Sit patiently, and inly ruminate
The morning's danger; and their gesture sad
Investing lank-lean cheeks, and war-worn coats,
Presenteth them unto the gazing moon
So many horrid ghosts. O, now, who will behold
The royal captain of this ruin'd band,
Walking from watch to watch, from tent to tent,
Let him cry—Praise and glory on his head!
For forth he goes, and visits all his host;
Bids them good-morrow, with a modest smile:
And calls them—brothers, friends, and countrymen.
Upon his royal face there is no note
How dread an army hath enrounded him;
Nor doth he dedicate one jot of colour
Unto the weary and all-watched night;
But freshly looks, and overbears *attaint* *weariness*
With cheerful semblance and sweet majesty;
That every wretch, pining and pale before,
Beholding him, plucks comfort from his looks:
A largess universal, like the sun,
His liberal eye doth give to every one,
Thawing cold fear.

Sonnets.

LIV.

O how much more doth beauty beauteous seem,
By that sweet ornament which truth doth give!
The rose looks fair, but fairer we it deem
For that sweet odour which doth in it live.
The *canker*-blooms have full as deep a dye *dog-rose*
As the perfumed tincture of the roses,
Hang on such thorns, and play as wantonly
When summer's breath their masked buds discloses:
But, for their virtue only is their show,
They live unwoo'd, and unrespected fade;
Die to themselves. Sweet roses do not so;
Of their sweet deaths are sweetest odours made:
And so of you, beauteous and lovely youth,
When that shall fade, by verse distils your truth.

LX.

Like as the waves make towards the pebbled shore,
So do our minutes hasten to their end;
Each changing place with that which goes before,
In sequent toil all forwards do contend.
Nativity, once in the main of light,
Crawls to maturity, wherewith being crown'd,
Crooked eclipses 'gainst his glory fight,
And Time, that gave, doth now his gift confound.
Time doth transfix the flourish set on youth,
And delves the parallels in beauty's brow;
Feeds on the rarities of nature's truth,
And nothing stands but for his scythe to mow.
And yet, to times in hope, my verse shall stand,
Praising thy worth, despite his cruel hand.

LXXI.

No longer mourn for me when I am dead
Than you shall hear the surly sullen bell
Give warning to the world that I am fled
From this vile world, with vilest worms to dwell:
Nay, if you read this line, remember not
The hand that writ it; for I love you so,
That I in your sweet thoughts would be forgot,
If thinking on me then should make you woe.
O, if (I say) you look upon this verse,
When I perhaps compounded am with clay,
Do not so much as my poor name rehearse;
But let your love even with my life decay:
Lest the wise world should look into your moan,
And mock you with me after I am gone.

Song from 'As You Like It.'

Blow, blow, thou winter wind,
Thou art not so unkind
As man's ingratitude;
Thy tooth is not so keen,
Because thou art not seen,
Although thy breath be rude.
Heigh, ho! sing, heigh, ho! unto the green holly:
Most friendship is feigning, most loving mere folly:
Then, heigh ho! the holly!
This life is most jolly.

Freeze, freeze, thou bitter sky,
Thou dost not bite so nigh
As benefits forgot:
Though thou the waters *warp*, *weave into ice*
Thy sting is not so sharp
As friend remembered not.
Heigh, ho! sing, heigh, ho! unto the green holly:
Most friendship is feigning, most loving, mere folly:
Then, heigh ho! the holly!
This life is most jolly.

Ben Jonson: 1573–1637.

From a Poem to the Memory of Shakspeare.

Soul of the age!
The applause, delight, the wonder of our stage!
My Shakspeare, rise! I will not lodge thee by
Chaucer, or Spenser, or bid Beaumont lie
A little further off, to make thee room:
Thou art a monument without a tomb,
And art alive still, while thy book doth live,
And we have wits to read, and praise to give.
That I not mix thee so, my brain excuses,
I mean with great but disproportioned Muses:
For if I thought my judgment were of years,
I should commit thee surely with thy peers,
And tell how far thou didst our Lyly[1] outshine,
Or sporting Kyd,[2] or Marlowe's[3] mighty line.
And though thou had small Latin and less Greek,
From thence to honour thee I will not seek
For names; but call forth thund'ring Æschylus,[4]
Euripides,[5] and Sophocles[5] to us,
Pacuvius,[6] Accius,[7] him of Cordova[8] dead,
To live again, to hear thy buskin tread,
And shake a stage: or when thy socks were on,
Leave thee alone for the comparison
Of all that insolent Greece or haughty Rome
Sent forth, or since did from their ashes come.
Triumph, my Britain, thou hast one to shew,
To whom all scenes of Europe homage owe.
He was not of an age, but for all time!
And all the Muses still were in their prime,
When, like Apollo, he came forth to warm
Our ears, or like a Mercury, to charm!
Nature herself was proud of his designs,
And joyed to wear the dressing of his lines!
Which were so richly spun, and woven so fit,
As, since, she will vouchsafe no other wit.
The merry Greek, tart Aristophanes,[9]
Neat Terence,[10] witty Plautus,[10] now not please;
But antiquated and deserted lie,
As they were not of nature's family.
Yet must I not give nature all; thy art,
My gentle Shakspeare, must enjoy a part.

1 John Lyly, born about 1554, wrote masques and plays for court entertainments. He was the originator of the affected style of writing called *Euphuism*.
2 Thomas Kyd, a play-writer about 1588. Jonson speaks sarcastically of Kyd, for he was the reverse of lively.
3 Christopher Marlowe, the greatest of Shakspeare's precursors. He was the first to introduce blank verse on the stage.
4 Æschylus, the father of Greek tragedy, born 525 B.C.
5 Euripides, born 480 B.C., and Sophocles, born about 495 B.C., were the other two great masters of Greek tragedy.
6 Pacuvius, one of the most celebrated of the early Roman tragedians, born about 220 B.C.
7 Accius, another Roman tragic poet, born about 170 B.C.
8 Lucan, a Roman poet, born here, 38 A.D.
9 Aristophanes, a Greek comic writer, born 444 B.C.
10 Terence, born 195 B.C., and Plautus, born 254 B.C., Roman comic poets.

For though the poet's matter nature be,
His art doth give the fashion; and, that he
Who casts to write a living line, must sweat—
Such as thine are—and strike the second heat
Upon the Muses' anvil; turn the same,
And himself with it, that he thinks to frame;
Or for the laurel, he may gain a scorn;
For a good poet 's made as well as born.
And such wert thou! Look how the father's face
Lives in his issue, even so the race
Of Shakspeare's mind and manners brightly shines
In his well-turned and true-filed lines:
In each of which he seems to shake a lance,
As brandished at the eyes of ignorance.
Sweet Swan of Avon! what a sight it were
To see thee in our water yet appear,
And make those flights upon the banks of Thames
That so did take Eliza and our James!
But stay, I see thee in the hemisphere
Advanced, and made a constellation there!
Shine forth, thou Star of Poets, and with rage,
Or influence, chide, or cheer the drooping stage,
Which since thy flight from hence hath mourned like night,
And despairs day, but for thy volume's light!

Hymn on the Nativity.

I sing the birth was born to-night,
The Author both of life and light:
The angels so did sound it,
And like the ravished shepherds said,
Who saw the light, and were afraid,
Yet searched, and true they found it.

The Son of God, th' Eternal King,
That did us all salvation bring,
And freed the soul from danger;
He whom the whole world could not *take*, *contain*
The Word, which heaven and earth did make;
Was now laid in a manger.

The Father's wisdom willed it so,
The Son's obedience knew no No,
Both wills were in one stature;
And as that Wisdom had decreed,
The Word was now made flesh indeed,
And took on Him our nature.

What comfort by him do we win,
Who made Himself the price of sin,
To make us heirs of glory!
See this Babe, all innocence;
A martyr born in our defence:
Can man forget the story?

Beaumont and Fletcher.

(Francis Beaumont, 1586—1615; John Fletcher, 1576—1625.)

Melancholy.

Hence, all you vain delights,
As short as are the nights
Wherein you spend your folly!
There 's nought in this life sweet,
If man were wise to see 't,
But only melancholy!

Welcome, folded arms, and fixed eyes,
A sigh that piercing mortifies,
A look that 's fastened to the ground,
A tongue chained up, without a sound!

Fountain heads, and pathless groves,
Places which pale passion loves!
Moonlight walks, when all the fowls
Are warmly housed, save bats and owls!
A midnight bell, a parting groan!
These are the sounds we feed upon;
Then stretch our bones in a still gloomy valley:
Nothing 's so dainty-sweet as lovely melancholy.

Song to Pan.[1]

All ye woods, and trees, and bow'rs,
All ye virtues and ye pow'rs
That inhabit in the lakes,
In the pleasant springs or brakes,
Move your feet
To our sound,
Whilst we greet
All this ground,
With his honour and his name
That defends our flocks from blame.

He is great, and he is just,
He is ever good, and must
Thus be honoured. Daffodilies,
Roses, pinks, and loved lilies,
Let us fling,
Whilst we sing,
Ever holy,
Ever holy,
Ever honoured, ever young!
Thus great Pan is ever sung.

[1] Among the Greeks, the great god of flocks and shepherds.

Robert Herrick: 1591—1674.

To Blossoms.

Fair pledges of a fruitful tree,
Why do ye fall so fast?
Your date is not so past,
But you may stay yet here awhile
To blush and gently smile,
And go at last.

What! were ye born to be
An hour or half's delight,
And so to bid good-night?
'Twas pity Nature brought ye forth,
Merely to shew your worth,
And lose you quite.

But you are lovely leaves, where we
May read, how soon things have
Their end, though ne'er so brave:
And after they have shewn their pride,
Like you, awhile, they glide
Into the grave.

To Daffodils.

Fair daffodils, we weep to see
You haste away so soon;
As yet the early-rising sun
Has not attained his noon:
Stay, stay,
Until the hast'ning day
Has run
But to the even-song;
And having prayed together, we
Will go with you along!

We have short time to stay as you;
We have as short a spring;
As quick a growth to meet decay,
As you or anything:
We die,
As your hours do; and dry
Away
Like to the summer's rain,
Or as the pearls of morning-dew,
Ne'er to be found again.

William Drummond: 1585—1649.

Spring.

Sweet Spring, thou com'st with all thy goodly train,
Thy head with flames, thy mantle bright with flowers,
The zephyrs curl the green locks of the plain,
The clouds for joy in pearls weep down their showers.
Sweet Spring, thou com'st—but ah! my pleasant hours,
And happy days, with thee come not again,
The sad memorials only of my pain
Do with thee come, which turn my sweet to sours.
Thou art the same which still thou wert before,
Delicious, lusty, amiable, fair,
But she whose breath embalmed thy wholesome air,
Is gone; nor gold, nor gems, can her restore.
Neglected virtue! seasons go and come,
While thine forgot lie closèd in a tomb.

The Book of the World.

Of this fair volume which we 'World' do name
If we the sheets and leaves could turn with care,
Of Him who it corrects and did it frame
We clear might read the art and wisdom rare;
Find out His power which wildest powers doth tame,
His providence extending everywhere,
His justice, which proud rebels doth not spare,
In every page—no period of the same.
But silly we, like foolish children, rest
Well pleased with coloured vellum, leaves of gold,
Fair dangling ribands; leaving what is best,
On the great Writer's *sense* ne'er taking hold;
Or if by chance we stay our minds on aught,
It is some picture on the margin wrought.

Thomas Carew: 1589—1639.

Spring.

Now that the winter's gone, the earth hath lost
Her snow-white robes, and now no more the frost
Candies the grass, or casts an icy cream
Upon the silver lake, or crystal stream:
But the warm sun thaws the benumbèd earth,
And makes it tender, gives a sacred birth
To the dead swallow, wakes in hollow tree
The drowsy cuckoo and the humble bee.
Now do a quire of chirping minstrels bring
In triumph to the world, the youthful Spring:
The valleys, hills, and woods, in rich array,
Welcome the coming of the longed-for May.
Now all things smile; only my love doth lower;
Nor hath the scalding noon-day sun the power
To melt that marble ice, which still doth hold
Her heart congealed, and makes her pity cold.

John Milton: 1608—1674.

Lycidas.

[In this monody the author bewails a learned friend, unfortunately drowned in his passage from Chester, on the Irish Sea, 1637; and by occasion foretells the ruin of our corrupted clergy, then in their height.]

Yet once more, O ye laurels, and once more,
Ye myrtles brown, with ivy never sere,
I come to pluck your berries harsh and crude;
And, with forced fingers rude,
Shatter your leaves before the mellowing year:
Bitter constraint, and sad occasion dear,
Compels me to disturb your season due:
For Lycidas is dead, dead ere his prime,
Young Lycidas, and hath not left his peer.
Who would not sing for Lycidas? he knew
Himself to sing, and build the lofty rhyme.
He must not float upon his watery bier
Unwept, and *welter* to the parching wind, *roll to and fro*
Without the meed of some melodious tear.
Begin, then, Sisters of the sacred well,[1]
That from beneath the seat of Jove doth spring;
Begin, and somewhat loudly sweep the string.
Hence with denial vain, and coy excuse:
So may some gentle *Muse* *poet*
With lucky words[2] favour my destined urn;
And as he passes turn,
And bid fair peace be to my sable shroud.
For we were nursed upon the self-same hill,
Fed the same flock, by fountain, shade, and rill.[3]
Together both, ere the high lawns appeared
Under the opening eyelids of the Morn,
We drove *a-field*, and both together heard *to the fields*
What time the gray-fly winds her sultry horn,
Battening our flocks with the fresh dews of night, *feeding*
Oft till the star that rose at evening, bright,
Toward heaven's descent had sloped his westering wheel.
Meanwhile the rural ditties were not mute,
Tempered to the oaten flute;
Rough Satyrs danced, and Fauns with cloven heel
From the glad sound would not be absent long;
And old Damœtas[4] loved to hear our song.
But, O the heavy change, now thou art gone,
Now thou art gone, and never must return!
Thee, Shepherd, thee the woods and desert caves,
With wild thyme and the gadding vine o'ergrown,
And all their echoes, mourn:
The willows and the hazel copses green
Shall now no more be seen
Fanning their joyous leaves to thy soft lays.

[1] A fount of the poet's own creation. [2] *Lucky words*, words of good omen.
[3] They belonged to the same college, and had the same pursuits.
[4] One of Virgil's characters, supposed to have reference here to some person of eminence in the college.

As killing as the canker to the rose,
Or taint-worm to the *weanling* herds that graze, *newly weaned*
Or frost to flowers, that their gay wardrobe wear,
When first the white-thorn blows;
Such, Lycidas, thy loss to shepherds' ear.
Where were ye, Nymphs, when the remorseless deep
Closed o'er the head of your loved Lycidas?
For neither were ye playing on the steep,
Where your old bards, the famous Druids, lie,
Nor on the shaggy top of *Mona* high, *Anglesea*
Nor yet where *Deva* spreads her wizard stream: *the Dee*
Ay me! I fondly dream!
Had ye been there—for what could that have done?
What could the Muse herself that Orpheus bore,[1]
The Muse herself, for her enchanting son,
Whom universal Nature did lament,
When by the rout that made the hideous roar,
His gory visage down the stream was sent,
Down the swift Hebrus, to the Lesbian shore?
Alas! what boots it with incessant care
To tend the homely, slighted, shepherd's trade,
And strictly *meditate* the thankless Muse? *practise*
Were it not better done, as others use,
To sport with Amaryllis[2] in the shade,
Or with the tangles of Neæra's[3] hair?
Fame is the spur that the clear spirit doth raise—
That last infirmity of noble mind—
To scorn delights, and live laborious days;
But the fair guerdon when we hope to find,
And think to burst out into sudden blaze,
Comes the blind Fury with the abhorrèd shears,
And slits the thin-spun life. 'But not the praise,'
Phœbus[4] replied, and touched my trembling ears;
'Fame is no plant that grows on mortal soil,
Nor in the glistering foil
Set-off to the world, nor in broad rumour lies;
But lives, and spreads aloft by those pure eyes,
And perfect witness of all-judging Jove;
As he pronounces lastly on each deed,
Of so much fame in heaven expect thy meed.'
O fountain Arethuse,[5] and thou honoured flood,
Smooth-sliding Mincius,[6] crowned with vocal reeds,
That strain I heard was of a higher mood:
But now my oat proceeds,
And listens to the herald[7] of the sea
That came in Neptune's plea.
He asked the waves, and asked the *felon* winds, *wicked*

1 Calliope, the Muse of epic poetry, was the mother of Orpheus. Orpheus was torn to pieces by the women of Thrace, whom he had treated with contempt. His head was thrown upon the river Hebrus, down which it rolled to the sea, and was borne across to the island of Lesbos.
2 The mistress of the shepherd Tityrus, one of Virgil's characters.
3 The mistress of the shepherd Ægon, one of Virgil's characters.
4 Apollo, the god of poetry.
5 A celebrated fountain near Syracuse.
6 The river Mincio, near which Virgil was born.
7 Triton, deputed by Neptune, the god of the sea, to make a judicial inquiry into the matter.

What hard mishap hath doomed this gentle swain?
And questioned every gust of rugged wings
That blows from off each beakèd promontory:
They knew not of his story;
And sage Hippotades[1] their answer brings,
That not a blast was from his dungeon strayed;
The air was calm, and on the level brine
Sleek Panope[2] with all her sisters played.
It was that fatal and perfidious bark,
Built in the eclipse, and rigged with curses dark,
That sunk so low that sacred head of thine.
Next Camus,[3] reverend sire, went footing slow,
His mantle hairy, and his bonnet sedge,
Inwrought with figures dim, and on the edge
Like to that sanguine flower inscribed with woe.[4]
'Ah! who hath reft,' quoth he, 'my dearest *pledge?*' *child*
Last came, and last did go,
The pilot of the Galilean lake;[5]
Two massy keys he bore of metals twain
(The golden opes, the iron shuts amain),
He shook his mitred locks, and stern bespake:
'How well could I have spared for thee, young swain,
Enow of such as for their bellies' sake
Creep, and intrude, and climb into the fold!
Of other care they little reckoning make,
Than how to scramble at the shearers' feast,
And shove away the worthy bidden guest;
Blind mouths! that scarce themselves know how to hold
A sheep-hook, or have learned aught else the least
That to the faithful herdman's art belongs!
What recks it them? What need they? They are sped;
And, when they list, their lean and flashy songs
Grate on their scrannel[6] pipes of wretched straw;
The hungry sheep look up, and are not fed,
But, swoln with wind and the rank mist they draw,
Rot inwardly, and foul contagion spread:
Beside what the grim wolf with privy paw
Daily devours apace, and nothing said:
But that two-handed engine[7] at the door
Stands ready to smite once, and smite no more.'
Return, Alpheus,[8] the dread voice is past
That shrunk thy streams; return, Sicilian Muse,
And call the vales, and bid them hither cast
Their bells, and flowerets of a thousand hues.
Ye valleys low, where the mild whispers *use* *frequent*

1 Æolus, son of Hippotes, and ruler of the winds.
2 One of the daughters of the sea-god Nereus, who attended Neptune, riding on sea-horses.
3 The god of the sluggish river Cam, on which Cambridge stands.
4 The hyacinth, said to have sprung from the blood of Hyacinthus, a Spartan youth, who was killed by a blow from a quoit. Its petals were said to bear the Greek words *ai, ai,* exclamations of woe.
5 St Peter, who had a boat on the Sea of Galilee.
6 Producing a weak screeching sound.
7 Perhaps the two-edged sword of the Apocalypse is meant, or the metaphorical axe in the gospel, which was to be laid to the root of the tree.
8 A stream supposed to be connected with the fountain Arethusa mentioned above.

Of shades, and wanton winds, and gushing brooks,
On whose fresh lap the swart-star[1] *sparely* looks, *rarely*
Throw hither all your quaint enamelled eyes,
That on the green turf suck the honied showers,
And purple all the ground with vernal flowers.
Bring the *rathe* primrose that forsaken dies, *early*
The tufted crow-toe, and pale jessamine,
The white pink, and the pansy *freaked* with jet, *spotted*
The glowing violet,
The musk-rose, and the well-attired[2] woodbine,
With cowslips wan that hang the pensive head,
And every flower that sad embroidery wears:
Bid amaranthus all his beauty shed,
And daffodillies fill their cups with tears,
To strew the laureat hearse[3] where Lycid lies.
For, so to interpose a little ease,
Let our frail thoughts dally with false surmise;
Ay me! whilst thee the shores and sounding seas
Wash far away, where'er thy bones are hurled,
Whether beyond the stormy Hebrides,
Where thou perhaps, under the whelming tide,
Visit'st the bottom of the monstrous world;[4]
Or whether thou, to our moist vows denied,
Sleep'st by the fable of Bellerus old,[5]
Where the great Vision of the guarded Mount
Looks towards Namancos and Bayona's hold.
Look homeward, Angel, now, and melt with ruth:
And, O ye dolphins, waft the hapless youth.
Weep no more, woeful shepherds, weep no more;
For Lycidas, your sorrow, is not dead,
Sunk though he be beneath the watery floor;
So sinks the day-star in the ocean-bed,
And yet anon *repairs* his drooping head, *renews*
And tricks his beams, and with new-spangled ore
Flames in the forehead of the morning sky:
So Lycidas sunk low, but mounted high,
Through the dear might of Him that walked the waves,
Where, other groves and other streams along,
With nectar pure his oozy locks he laves,
And hears the *unexpressive* nuptial song, *not to be expressed*
In the blest kingdoms meek of joy and love.
There entertain him all the saints above
In solemn troops and sweet societies,

1 The swarthy, black, or injurious star, the dog-star
2 Having a handsome attire or head-dress, its flower.
3 Anciently a monument to the memory of the dead.
4 'The monstrous world,' the world of monsters.
5 Lines 160-162 were long a puzzle to commentators, and are still somewhat obscure. The place called 'the fable of Bellerus old' was St Michael's Mount, in Cornwall. It was anciently called Bellerium, from which Milton has formed the name Bellerus, as that of one of the ancient giants of Britain. He represents the archangel Michael appearing as a 'Vision' on this mount, called 'guarded' because it was formerly fortified. 'Namancos' and 'Bayona' are places on the west coast of Gallicia, in Spain. The sense of lines 161-164 seems to be, as given by Todd, 'O Angel (seated on the guarded mount), look no longer *seaward* to Namancos and Bayona's hold: rather turn your eyes to another object. Look *homeward* or *landward*, look towards your *own coast now*, and view with pity the corpse of the shipwrecked Lycidas floating thither.'

That sing and, singing, in their glory move,
And wipe the tears for ever from his eyes.
Now, Lycidas, the shepherds weep no more;
Henceforth, thou art the Genius of the shore,
In thy large recompense, and shalt be good
To all that wander in that perilous flood.

Thus sang the uncouth swain to the oaks and rills,
While the still Morn went out with sandals gray;
He touched the tender *stops* of various quills, *holes*
With eager thought warbling his Doric[1] lay:
And now the sun had stretched out all the hills,
And now was dropt into the western bay;
At last he rose, and twitched his mantle blue;
To-morrow to fresh woods and pastures new.

At a Solemn Music.

Blest pair of Sirens, *pledges* of Heaven's joy, *offspring*
Sphere-born harmonious sisters, Voice and Verse,
Wed your divine sounds, and mixed power employ,
Dead things with inbreathed sense able to pierce;
And to our high-raised phantasy present
That undisturbèd song of pure *concent*, *concert*
Aye sung before the sapphire-coloured throne
To Him that sits thereon,
With saintly shout, and solemn jubilee;
Where the bright Seraphim in burning row
Their loud uplifted angel-trumpets blow;
And the Cherubic host in thousand quires
Touch their immortal harps of golden wires,
With those just Spirits that wear victorious palms,
Hymns devout and holy psalms
Singing everlastingly:
That we on earth, with undiscording voice,
May rightly answer that melodious *noise;* *chorus*
As once we did, till disproportioned sin
Jarred against Nature's chime, and with harsh din
Broke the fair music that all creatures made
To their great Lord, whose love their motion swayed
In perfect diapason, whilst they stood,
In first obedience and their state of good.
O may we soon again renew that song,
And keep in tune with Heaven, till God ere long
To his celestial *consort* us unite, *chorus, band*
To live with Him, and sing in endless morn of light!

[1] 'Doric,' *i.e.* pastoral. The name Lycidas was adopted from the Greek poet Theocritus, who wrote in the Doric dialect.

George Herbert: 1593—1632.

Sunday.

1.

O day most calm, most bright,
The fruit of this, the next world's bud,
The indorsement of supreme delight,
Writ by a Friend, and with his blood;
The couch of time; care's balm and bay;
The week were dark, but for thy light:
Thy Torch doth shew the way.

2.

The other days and thou
Make up one man; whose face thou art,
Knocking at heaven with thy brow:
The working-days are the back-part;
The burden of the week lies there,
Making the whole to stoop and bow,
Till thy release appear.

3.

Man had straight forward gone
To endless death; but thou dost pull
And turn us round to look on One,
Whom, if we were not very dull,
We could not choose but look on still;
Since there is no place so alone
The which he doth not fill.

4.

Sundays the pillars are,
On which heaven's palace archèd lies:
The other days fill up the spare
And hollow room with vanities.
They are the fruitful beds and borders
In God's rich garden: that is bare
Which parts their ranks and orders.

5.

The Sundays of man's life,
Threaded together on time's string,
Make bracelets to adorn the wife
Of the eternal glorious King.
On Sunday heaven's gate stands ope;
Blessings are plentiful and rife,
More plentiful than hope.

* * * * *

6.

Thou art a day of mirth:
And where the week-days trail on ground,
Thy flight is higher, as thy birth:
O let me take thee at the bound,
Leaping with thee from seven to seven,
Till that we both, being tossed from earth,
Fly hand in hand to heaven!

Virtue.

1.

Sweet Day! so cool, so calm, so bright,
The bridal of the earth and sky,
The dew shall weep thy fall to-night;
For thou must die.

2.

Sweet Rose! whose hue angry and brave
Bids the rash gazer wipe his eye,
Thy root is ever in its grave,
And thou must die.

3.

Sweet Spring! full of sweet days and roses,
A box where sweets compacted lie,
My music shews ye have your closes;
And all must die.

4.

Only a sweet and virtuous soul,
Like seasoned timber, never gives;
But, though the whole world turn to coal,
Then chiefly lives.

Abraham Cowley: 1618—1667.

The Swallow.

Foolish prater! what dost thou
So early at my window do
With thy tuneless serenade?
Well it had been had Tereus[1] made
Thee as dumb as Philomel;
There his knife had done but well.
In thy undiscovered nest
Thou dost all the winter rest,
And dreamest o'er thy summer joys
Free from the stormy season's noise;
Free from the ill thou 'st done to me;
Who disturbs or seeks out thee?
Hadst thou all the charming notes
Of the woods' poetic throats,
All thy art could never pay
What thou 'st ta'en from me away.
Cruel bird! thou 'st ta'en away
A dream out of my arms to-day;
A dream that ne'er must equalled be
By all that waking eyes may see:
Thou this damage to repair,
Nothing half so sweet or fair,
Nothing half so good canst bring,
Though men say thou bring'st the Spring.

[1] A reference to the mythological story of Tereus, who deprived Philomela, the daughter of Pandion, of her tongue. She was afterwards changed into a nightingale.

Samuel Butler : 1612—1680.

Hudibras's Equipment.

When civil dudgeon first grew high,
And men fell out, they knew not why;
When hard words, jealousies, and fears,
Set folks together by the ears; . . . .
When Gospel-trumpeter, surrounded
With long-eared rout, to battle sounded;
And pulpit, drum ecclesiastic,
Was beat with fist instead of a stick;
Then did Sir Knight abandon dwelling,
And out he rode a colonelling.[1]

* * * *

His breeches were of rugged woollen,
And had been at the siege of Bullen;
Through they were lined with many a piece
Of ammunition, bread, and cheese,
And fat black puddings, proper food
For warriors that delight in blood:
For, as we said, he always chose
To carry victual in his hose,
That often tempted rats and mice
The ammunition to surprise;
And when he put a hand but in
The one or t' other magazine,
They stoutly on defence on't stood,
And from the wounded foe drew blood,
And till they were stormed, and beaten out,
Ne'er left the fortified redoubt;
And though knights-errant, as some think,
Of old did neither eat nor drink,
Because, when thorough deserts vast,
And regions desolate, they past,
Where belly-timber above ground,
Or under, was not to be found,
Unless they grazed, there's not one word
Of their provision on record;
Which made some confidently write,
They had no stomachs but to fight.

* * * *

His puissant sword unto his side,
Near his undaunted heart, was tied,
With basket-hilt that would hold broth,
And serve for fight and dinner both;
In it he melted lead for bullets
To shoot at foes, and sometimes pullets,
To whom he bore so fell a grutch,[2]
He ne'er gave quarter to any such.
The trenchant blade, Toledo[3] trusty,
For want of fighting was grown rusty,
And eat into itself, for lack
Of somebody to hew and hack:
The peaceful scabbard, where it dwelt,
The rancour of its edge had felt;
For of the lower end two handful
It had devoured, it was so manful,
And so much scorned to lurk in case,
As if it durst not shew his face.

* * * *

This sword a dagger had, his page,
That was but little for his age,
And therefore waited on him so,
As dwarfs upon knights-errant do:
It was a serviceable dudgeon,
Either for fighting or for drudging:
When it had stabbed, or broke a head,
It would scrape trenchers, or chip bread;
Toast cheese or bacon, though it were
To bait a mouse-trap, 'twould not care;
'Twould make clean shoes, and in the earth
Set leeks and onions, and so forth. . . . .
In the holsters, at his saddle-bow,
Two aged pistols he did stow,
Among the surplus of such meat
As in his hose he could not get:
These would inveigle rats with the scent,
To forage when the cocks were bent,
And sometimes catch 'em with a snap,
As cleverly as the ablest trap:
They were upon hard duty still,
And every night stood sentinel,
To guard the magazine i' the hose
From two-legg'd and from four-legg'd foes.
Thus clad and fortified, Sir Knight,
From peaceful home, set forth to fight.
But first, with nimble active force,
He got on the outside of his horse!
For having but one stirrup tied
To his saddle on the further side,
It was so short he had much ado
To reach it with his desperate toe;
But after many strains and heaves,
He got up to the saddle-eaves,
From whence he vaulted into the seat
With so much vigour, strength, and heat,
That he had almost tumbled over
With his own weight, but did recover,
By laying hold on tail and mane,
Which oft he used instead of rein.

[1] Playing the colonel.
[2] Grudge.
[3] Toledo in Spain, so famed for its swords, that a sword was called a Toledo.

John Dryden: 1631–1700.

A Song for St Cecilia's Day.

1.

From harmony, from heavenly harmony,
This universal frame began:
When nature underneath a heap
Of jarring atoms lay,
And could not heave her head,
The tuneful voice was heard from high:
'Arise, ye more than dead.'
Then cold, and hot, and moist, and dry,
In order to their stations leap,
And Music's power obey.
From harmony, from heavenly harmony,
This universal frame began:
From harmony to harmony
Through all the compass of the notes it ran,
The diapason closing full in Man.

2.

What passion cannot Music raise and quell?
When Jubal struck the chorded shell,
His listening brethren stood around,
And, wondering, on their faces fell
To worship that celestial sound:
Less than a God they thought there could not dwell
Within the hollow of that shell,
That spoke so sweetly, and so well.
What passion cannot Music raise and quell?

3.

The trumpet's loud clangor
Excites us to arms,
With shrill notes of anger,
And mortal alarms.
The double double double beat
Of the thundering drum
Cries: Hark! the foes come;
Charge, charge, 'tis too late to retreat.

4.

The soft complaining flute
In dying notes, discovers
The woes of hopeless lovers,
Whose dirge is whispered by the warbling lute.

5.

Sharp violins proclaim
Their jealous pangs, and desperation,
Fury, frantic indignation,
Depth of pains, and height of passion,
For the fair, disdainful dame.

6.

But oh! what art can teach,
What human voice can reach,
The sacred organ's praise?
Notes inspiring holy love,

Notes that wing their heavenly ways
To mend the choirs above.

7.

Orpheus[1] could lead the savage race;
And trees uprooted left their place,
Sequacious of the lyre; *following*
But bright Cecilia[2] raised the wonder higher:
When to her organ vocal breath was given,
An angel heard, and straight appeared,
Mistaking earth for heaven.

GRAND CHORUS.

As from the power of sacred lays
The spheres began to move,
And sung the great Creator's praise
To all the blessed above;
So when the last and dreadful hour
This crumbling pageant shall devour,
The trumpet shall be heard on high,
The dead shall live, the living die,
And Music shall untune the sky.

From 'The Flower and the Leaf,' a Tale from Chaucer.

Now turning from the wintry signs, the sun
His course exalted through the Ram had run,
And whirling up the skies, his chariot drove
Through Taurus, and the lightsome realms of love;
Where Venus from her orb descends in showers,
To glad the ground, and paint the fields with flowers:
When first the tender blades of grass appear,
And buds, that yet the blast of Eurus[3] fear,
Stand at the door of life, and doubt to clothe the year;
Till gentle heat, and soft repeated rains,
Make the green blood to dance within their veins;
Then, at their call emboldened, out they come,
And swell the *gems*, and burst the narrow room; *buds*
Broader and broader yet, their blooms display,
Salute the welcome sun, and entertain the day.
Then from their breathing souls the sweets repair
To scent the skies, and purge the unwholesome air:
Joy spreads the heart, and, with a general song,
Spring issues out, and leads the jolly months along. . . . .
When Chanticleer[4] the second watch had sung,
Scorning the scorner sleep, from bed I sprung;
And dressing, by the moon, in loose array,
Passed out in open air, *preventing* day, *going before*
And sought a goodly grove, as fancy led my way.
Straight as a line in beauteous order stood
Of oaks unshorn a venerable wood;

1 Orpheus is said to have been presented by Apollo with a lyre, which enchanted beasts, trees, rocks, &c.
2 The patroness of music, and regarded as the inventor of the organ.
3 Eurus, the east wind.
4 Chanticleer, the cock, so called from his crowing so clearly.

Fresh was the grass beneath, and every tree,
At distance planted in a due degree,
Their branching arms in air with equal space
Stretched to their neighbours with a long embrace;
And the new leaves on every bough were seen,
Some ruddy coloured, some of lighter green.
The painted birds, companions of the spring,
Hopping from spray to spray, were heard to sing.
Both eyes and ears received a like delight,
Enchanting music, and a charming sight.
On Philomel[1] I fixed my whole desire,
And listened for the queen of all the quire;
Fain would I hear her heavenly voice to sing;
And wanted yet an omen to the spring. . . . .
Thus as I mused, I cast aside my eye,
And saw a medlar-tree was planted nigh.
The spreading branches made a goodly show,
And full of opening blooms was every bough:
A goldfinch there I saw with gaudy pride
Of painted plumes, that hopped from side to side,
Still pecking as she passed; and still she drew
The sweets from every flower, and sucked the dew:
Sufficed at length, she warbled in her throat,
And tuned her voice to many a merry note,
But indistinct, and neither sweet nor clear,
Yet such as soothed my soul, and pleased my ear.
  Her short performance was no sooner tried,
When she I sought, the nightingale, replied:
So sweet, so shrill, so variously she sung,
That the grove echoed, and the valleys rung,
And I so ravished with her heavenly note,
I stood entranced, and had no room for thought,
But all o'erpowered with ecstasy of bliss,
Was in a pleasing dream of paradise;
At length I waked, and looking round the bower,
Searched every tree, and pried on every flower,
If anywhere by chance I might espy
The rural poet of the melody;
For still methought she sung not far away:
At last I found her on a laurel spray.
Close by my side she sat, and fair in sight,
Full in a line, against her opposite,
Where stood with eglantine the laurel twined;
And both their native sweets were well conjoined.
  On the green bank I sat, and listened long;
(Sitting was more convenient for the song):
Nor till her lay was ended could I move,
But wished to dwell for ever in the grove.
Only methought the time too swiftly passed,
And every note I feared would be the last.
My sight, and smell, and hearing, were employed,
And all three senses in full gust enjoyed.

[1] Philomel, the nightingale.

Joseph Addison: 1672—1719.

An Ode.

1.
How are thy servants blest, O Lord!
How sure is their defence!
Eternal wisdom is their guide,
Their help Omnipotence.

2.
In foreign realms, and lands remote,
Supported by thy care,
Through burning climes I passed unhurt,
And breathed in tainted air.

3.
Thy mercy sweetened every soil,
Made every region please;
The hoary Alpine hills it warmed,
And smoothed the Tyrrhene seas.

4.
Think, O my soul, devoutly think,
How, with affrighted eyes,
Thou saw'st the wide-extended deep,
In all its horrors rise.

5.
Confusion dwelt on every face,
And fear in every heart;
When waves on waves, and gulfs on gulfs,
O'ercame the pilot's art.

6.
Yet then from all my griefs, O Lord!
Thy mercy set me free;
Whilst in the confidence of prayer,
My soul took hold on thee.

7.
For though in dreadful whirls we hung
High on the broken wave,
I knew thou wert not slow to hear,
Nor impotent to save.

8.
The storm was laid, the winds retired,
Obedient to thy will;
The sea, that roared at thy command,
At thy command was still.

9.
In midst of dangers, fears, and death,
Thy goodness I 'll adore;
And praise thee for thy mercies past,
And humbly hope for more.

10.
My life, if thou preserv'st my life,
Thy sacrifice shall be;
And death, if death must be my doom,
Shall join my soul to thee.

Matthew Prior: 1664—1721.

A Simile.

Dear Thomas, didst thou never pop
Thy head into a tinman's shop?
There, Thomas, didst thou never see
('Tis but by way of simile)
A squirrel spend his little rage
In jumping round a rolling cage;
The cage, as either side turn'd up,
Striking a ring of bells at top?—
Moved in the orb, pleased with the chimes,
The foolish creature thinks he climbs:
But here or there, turn wood or wire,
He never gets two inches higher.
So fares it with those merry blades,
That frisk it under Pindus' shades.
In noble song, and lofty odes,
They tread on stars, and talk with gods;
Still dancing in an airy round,
Still pleased with their own verses' sound;
Brought back, how fast soe'er they go,
Always aspiring, always low.

John Gay: 1688—1732.

The Turkey and the Ant.

In other men we faults can spy,
And blame the mote that dims their eye,
Each little speck and blemish find;
To our own stronger errors blind.
A turkey, tired of common food,
Forsook the barn, and sought the wood;
Behind her ran an infant train,
Collecting here and there a grain.
'Draw near, my birds!' the mother cries;
'This hill delicious fare supplies;
Behold the busy negro race,
See millions blacken all the place!
Fear not; like me, with freedom eat;
An ant is most delightful meat.
How blessed, how envied, were our life,
Could we but 'scape the poulterer's knife!
But man, cursed man, on turkeys preys,
And Christmas shortens all our days.
Sometimes with oysters we combine,
Sometimes assist the savoury chine;
From the low peasant to the lord,
The turkey smokes on every board,
Sure men for gluttony are cursed,
Of the seven deadly sins the worst.'
An ant, who climbed beyond his reach,
Thus answered from the neighbouring beech:
'Ere you remark another's sin,
Bid thy own conscience look within;
Control thy more voracious bill,
Nor for a breakfast nations kill.'

Alexander Pope: 1688–1744.

The Messiah.

Ye nymphs of Solyma![1] begin the song:
To heavenly themes sublimer strains belong.
The mossy fountains and the sylvan shades,
The dreams of Pindus and the Aonian maids,[2]
Delight no more—O thou my voice inspire,
Who touched Isaiah's hallowed lips with fire!
Rapt into future times, the bard begun:
A Virgin shall conceive, a Virgin bear a Son!
From Jesse's root behold a branch arise,
Whose sacred flower with fragrance fills the skies:
The ethereal spirit o'er its leaves shall move,
And on its top descends the mystic Dove.
Ye heavens! from high the dewy nectar pour,
And in soft silence shed the kindly shower.
The sick and weak the healing plant shall aid,
From storms a shelter, and from heat a shade.
All crimes shall cease, and ancient frauds shall fail;
Returning Justice lift aloft her scale;
Peace o'er the world her olive wand extend,
And white-robed Innocence from heaven descend.
Swift fly the years, and rise the expected morn!
Oh, spring to light, auspicious Babe, be born!
See, nature hastes her earliest wreaths to bring,
With all the incense of the breathing spring!
See lofty Lebanon his head advance!
See nodding forests on the mountains dance!
See spicy clouds from lowly Sharon rise,
And Carmel's flowery top perfume the skies!
Hark! a glad voice the lonely desert cheers;
Prepare the way! a God, a God appears!
A God, a God! the vocal hills reply;
The rocks proclaim the approaching Deity.
Lo! earth receives him from the bending skies;
Sink down, ye mountains; and ye valleys, rise;
With heads declined, ye cedars, homage pay;
Be smooth, ye rocks: ye rapid floods, give way!
The Saviour comes! by ancient bards foretold:
Hear him, ye deaf: and all ye blind, behold!
He from thick films shall purge the visual ray,
And on the sightless eyeball pour the day:
'Tis he the obstructed paths of sound shall clear,
And bid new music charm the unfolding ear:
The dumb shall sing, the lame his crutch forego,
And leap exulting like the bounding roe.
No sigh, no murmur, the wide world shall hear;
From every face he wipes off every tear.
In adamantine chains shall death be bound,
And hell's grim tyrant feel the eternal wound.

1 Jerusalem, the Latin name of which was Hierosolyma.
2 Pindus, a range of mountains in Northern Greece, sacred to the Muses, who are called Aonian, from their frequenting Mount Helicon in Bœotia, the ancient inhabitants of which were called Aones.

As the good shepherd tends his fleecy care,
Seeks freshest pasture, and the purest air;
Explores the lost, the wandering sheep directs,
By day o'ersees them, and by night protects;
The tender lambs he raises in his arms,
Feeds from his hand, and in his bosom warms;
Thus shall mankind his guardian care engage,
The promised father of the future age.
No more shall nation against nation rise,
Nor ardent warriors meet with hateful eyes;
Nor fields with gleaming steel be covered o'er,
The brazen trumpets kindle rage no more:
But useless lances into scythes shall bend,
And the broad falchion in a ploughshare end.
Then palaces shall rise; the joyful son
Shall finish what his short-lived sire begun;
Their vines a shadow to their race shall yield,
And the same hand that sowed, shall reap the field.
The swain in barren deserts with surprise
Sees lilies spring, and sudden verdure rise;
And starts, amidst the thirsty wilds to hear
New falls of water murmuring in his ear.
On rifted rocks, the dragon's late abodes,
The green reed trembles, and the bulrush nods.
Waste sandy valleys, once perplexed with thorn,
The spiry fir and shapely box adorn:
To leafless shrubs the flowery palms succeed,
And odorous myrtle to the noisome weed.
The lambs with wolves shall graze the verdant mead,
And boys in flowery bands the tiger lead:
The steer and lion at one crib shall meet,
And harmless serpents lick the pilgrim's feet.
The smiling infant in his hand shall take
The crested basilisk and speckled snake;
Pleased, the green lustre of the scales survey,
And with their forky tongue shall innocently play.
Rise, crowned with light, imperial Salem, rise!
Exalt thy towery head, and lift thy eyes!
See a long race thy spacious courts adorn!
See future sons and daughters yet unborn,
In crowding ranks on every side arise,
Demanding life, impatient for the skies!
See barbarous nations at thy gates attend,
Walk in thy light, and in thy temple bend!
See thy bright altars thronged with prostrate kings,
And heaped with products of Sabean[1] springs.
For thee Idume's[2] spicy forests blow,
And seeds of gold in Ophir's[3] mountains glow.
See heaven its sparkling portals wide display,
And break upon thee in a flood of day!
No more the rising sun shall gild the morn,
Nor evening Cynthia[4] fill her silver horn;

[1] Saba, Arabia Felix, renowned for its aromatics. [2] Idumea, now Arabia Petræa.
[3] Ophir, a region from which gold was anciently obtained. Its situation is uncertain.
[4] The goddess of the moon, so called from her birthplace, Mt. Cynthus, in the isle of Delos.

But lost, dissolved in thy superior rays,
One tide of glory, one unclouded blaze
O'erflow thy courts: the Light himself shall shine
Revealed, and God's eternal day be thine!
The seas shall waste, the skies in smoke decay,
Rocks fall to dust, and mountains melt away;
But fixed his word, his saving power remains;
Thy realm for ever lasts, thy own Messiah reigns!

Edward Young: 1681–1765.

Past Hours.—From 'Night Thoughts.'

These hours that lately smiled, where are they now?
Pallid to thought, and ghastly! drowned, all drowned
In that great deep, which nothing disembogues!
And, dying, they bequeathed thee small renown.
The rest are on the wing: how fleet their flight!
Already has the fatal train took fire;
A moment, and the world's blown up to thee;
The sun is darkness, and the stars are dust.
'Tis greatly wise to talk with our past hours;
And ask them, what report they bore to heaven;
And how they might have borne more welcome news.
Their answers form what men experience call;
If Wisdom's friend, her best; if not, worst foe.
'Oh, reconcile them!' kind Experience cries;
'There 's nothing here, but what as nothing weighs;
The more our joy, the more we know it vain;
And by success are tutored to despair.'
Nor is it only thus, but must be so.
Who knows not this, though gray, is still a child.
Loose then from earth the grasp of fond desire,
Weigh anchor, and some happier clime explore.

Piety.—From 'Night Thoughts.'

On piety, humanity is built;
And, on humanity, much happiness;
And yet still more on piety itself.
A soul in commerce with her God, is heaven;
Feels not the tumults and the shocks of life;
The whirls of passions, and the strokes of heart.
A Deity believed, is joy begun;
A Deity adored, is joy advanced;
A Deity beloved, is joy matured.
Each branch of piety delight inspires;
Faith builds a bridge from this world to the next,
O'er death's dark gulf, and all its horror hides;
Praise, the sweet exhalation of our joy,
That joy exalts, and makes it sweeter still;
Prayer ardent opens heaven, lets down a stream
Of glory on the consecrated hour
Of man, in audience with the Deity.
Who worships the great God, that instant joins
The first in heaven, and sets his foot on hell.

James Thomson: 1700—1748.

Spring Flowers.

Along these blushing borders, bright with dew,
And in yon mingled wilderness of flowers,
Fair-handed Spring unbosoms every grace:
Throws out the snowdrop and the crocus first;
The daisy, primrose, violet darkly blue,
And polyanthus of unnumbered dyes;
The yellow wallflower, stained with iron brown;
And lavish stock that scents the garden round;
From the soft wing of vernal breezes shed,
Anemones; auriculas, enriched
With shining meal o'er all their velvet leaves;
And full ranunculus, of glowing red.
Then comes the tulip race, where beauty plays
Her idle freaks: from family diffused
To family, as flies the father-dust,
The varied colours run; and, while they break
On the charmed eye, the exulting florist marks,
With secret pride, the wonders of his hand.
No gradual bloom is wanting; from the bud,
First-born of Spring, to Summer's musky tribes:
Nor hyacinths, of purest virgin white,
Low-bent, and blushing inward; nor jonquils,
Of potent fragrance; nor narcissus fair,
As o'er the fabled fountain[1] hanging still;
Nor broad carnations; nor gay-spotted pinks;
Nor, showered from every bush, the damask-rose.
Infinite numbers, delicacies, smells,
With hues on hues expression cannot paint,
The breath of Nature, and her endless bloom.
Hail! Source of Being! Universal Soul
Of heaven and earth! Essential Presence, hail!
To Thee I bend the knee; to Thee my thoughts,
Continual, climb; who, with a master-hand,
Hast the great whole into perfection touched.
By Thee the various vegetative tribes,
Wrapt in a filmy net, and clad with leaves,
Draw the live ether, and imbibe the dew.
By Thee disposed into congenial soils,
Stands each attractive plant, and sucks, and swells
The juicy tide; a twining mass of tubes.

Birds in Spring.

Hark, how loud the woods
Invite you forth in all your gayest trim.
Lend me your song, ye nightingales! O pour
The mazy-running soul of melody
Into my varied verse! while I deduce,

[1] According to the fable, Narcissus was a handsome youth, wholly inaccessible to the feeling of love. One of his rejected lovers having prayed to Nemesis to punish him, he was caused to fall in love with his own image reflected in a well. Unable to approach the shadow, Narcissus gradually perished with love, and his corpse was changed into the flower called after him.

From the first note the hollow cuckoo sings,
The symphony of Spring, and touch a theme
Unknown to fame—the passion of the groves.
When first the soul of love is sent abroad,
Warm through the vital air, and on the heart
Harmonious seizes, the gay troops begin,
In gallant thought, to plume the painted wing;
And try again the long-forgotten strain,
At first faint-warbled. But no sooner grows
The soft infusion prevalent, and wide,
Than, all alive, at once their joy o'erflows
In music unconfined. Up springs the lark,
Shrill-voiced and loud, the messenger of morn:
Ere yet the shadows fly, he mounted sings
Amid the dawning clouds, and from their haunts
Calls up the tuneful nations. Every copse
Deep-tangled, tree irregular, and bush
Bending with dewy moisture, o'er the heads
Of the coy quiristers that lodge within,
Are prodigal of harmony. The thrush
And woodlark, o'er the kind-contending throng
Superior heard, run through the sweetest length
Of notes; when listening Philomela deigns
To let them joy, and purposes, in thought
Elate, to make her night excel their day.
The black-bird whistles from the thorny brake;
The mellow bullfinch answers from the grove;
Nor are the linnets, o'er the flowering furze
Poured out profusely, silent: joined to these
Innumerous songsters, in the freshening shade
Of new-sprung leaves, their modulations mix
Mellifluous. The jay, the rook, the daw,
And each harsh pipe, discordant heard alone,
Aid the full concert; while the stockdove breathes
A melancholy murmur through the whole.

Rule Britannia.

1.

When Britain first, at Heaven's command,
Arose from out the azure main,
This was the charter of the land,
And guardian angels sung this strain:
'Rule, Britannia, rule the waves;
Britons never will be slaves.'

2.

The nations, not so blessed as thee,
Must, in their turns, to tyrants fall;
While thou shalt flourish great and free,
The dread and envy of them all.

3.

Still more majestic shalt thou rise,
More dreadful from each foreign stroke;
As the loud blast that tears the skies
Serves but to root thy native oak.

4.

Thee haughty tyrants ne'er shall tame;
All their attempts to bend thee down
Will but arouse thy generous flame,
But work their woe, and thy renown.

5.

To thee belongs the rural reign;
Thy cities shall with commerce shine;
All thine shall be the subject main;
And every shore it circles thine.

6.

The Muses, still with freedom found,
Shall to thy happy coast repair;
Blessed isle! with matchless beauty crowned,
And manly hearts to guard the fair:
'Rule, Britannia, rule the waves;
Britons never will be slaves.'

William Collins: 1721–1759.

Ode to Evening.

1.

If aught of oaten stop, or pastoral song,
May hope, chaste Eve, to soothe thy modest ear,
Like thy own solemn springs,
Thy springs, and dying gales;

2.

O nymph reserved, while now the bright-haired sun
Sits in yon western tent, whose cloudy skirts,
With *brede* ethereal wove, *braid*
O'erhang his wavy bed:

3.

Now air is hushed, save where the weak-eyed bat,
With short shrill shriek, flits by on leathern wing,
Or where the beetle winds
His small but sullen horn,

4.

As oft he rises midst the twilight path,
Against the pilgrim borne in heedless hum:
Now teach me, maid composed,
To breathe some softened strain,

5.

Whose numbers stealing through thy darkening vale,
May not unseemly with its stillness suit,
As, musing slow, I hail
Thy genial loved return!

6.

For when thy folding-star arising shews
His paly circlet, at his warning lamp
The fragrant hours, and elves
Who slept in buds the day,

7.

And many a nymph who wreathes her brows with sedge,
And sheds the freshening dew, and, lovelier still,
The pensive pleasures sweet
Prepare thy shadowy car.

8.

Then lead, calm votaress, where some sheety lake
Cheers the lone heath, or some time-hallowed pile,
Or upland fallows gray
Reflect its last cool gleam.

9.

But when chill blustering winds, or driving rain,
Forbid my willing feet, be mine the hut
That from the mountain's side
Views wilds and swelling floods,

10.

And hamlets brown, and dim-discovered spires;
And hears their simple bell, and marks o'er all
Thy dewy fingers draw
The gradual dusky veil.

11.
While Spring shall pour his showers, as oft he wont,
And bathe thy breathing tresses, meekest Eve!
While Summer loves to sport
Beneath thy lingering light:
12.
While sallow Autumn fills thy lap with leaves,
Or Winter yelling through the troublous air,
Affrights thy shrinking train,
And rudely rends thy robes:
13.
So long, sure found beneath the sylvan shed,
Shall Fancy, Friendship, Science, rose-lipped Health,
Thy gentlest influence own,
And hymn thy favourite name.

William Shenstone: 1714–1763.

From 'Hope.'

1.
My banks they are furnished with bees,
Whose murmur invites one to sleep;
My grottos are shaded with trees,
And my hills are white over with sheep.
I seldom have met with a loss,
Such health do my fountains bestow;
My fountains, all bordered with moss,
Where the harebells and violets grow.

2.
Not a pine in my grove is there seen,
But with tendrils of woodbine is bound;
Not a beech's more beautiful green,
But a sweetbrier entwines it around.
Not my fields in the prime of the year
More charms than my cattle unfold;
Not a brook that is limpid and clear,
But it glitters with fishes of gold.

3.
One would think she might like to retire
To the bower I have laboured to rear;
Not a shrub that I heard her admire,
But I hasted and planted it there.
O how sudden the jessamine strove
With the lilac to render it gay!
Already it calls for my love
To prune the wild branches away.

4.
From the plains, from the woodlands, and groves,
What strains of wild melody flow!
How the nightingales warble their loves,
From thickets of roses that blow!
And when her bright form shall appear,
Each bird shall harmoniously join
In a concert so soft and so clear,
As—she may not be fond to resign.

Thomas Gray: 1716—1771.

Ode on a Distant Prospect of Eton College.

1.

Ye distant spires, ye antique towers,
That crown the watery glade,
Where grateful science still adores
Her Henry's[1] holy shade;
And ye, that from the stately brow
Of Windsor's heights the expanse below
Of grove, of lawn, of mead survey; [among
Whose turf, whose shade, whose flowers
Wanders the hoary Thames along
His silver-winding way!

2.

Ah, happy hills! ah, pleasing shade!
Ah, fields beloved in vain!
Where once my careless childhood strayed,
A stranger yet to pain:
I feel the gales that from ye blow
A momentary bliss bestow,
As, waving fresh their gladsome wing,
My weary soul they seem to soothe,
And, redolent of joy and youth,
To breathe a second spring.

3.

Say, Father Thames, for thou hast seen
Full many a sprightly race,
Disporting on thy margent[2] green,
The paths of pleasure trace,
Who foremost now delight to cleave
With pliant arm thy glassy wave?
The captive linnet which inthral?
What idle progeny succeed
To chase the rolling circle's speed,
Or urge the flying ball?

4.

While some on earnest business bent
Their murmuring labours ply
'Gainst graver hours, that bring constraint
To sweeten liberty;
Some bold adventurers disdain
The limits of their little reign,
And unknown regions dare descry:
Still as they run, they look behind;
They hear a voice in every wind,
And snatch a fearful joy.

5.

Gay hope is theirs, by fancy fed,
Less pleasing when possessed;
The tear forgot as soon as shed,
The sunshine of the breast.
Theirs buxom health of rosy hue,
Wild wit, invention ever new,
And lively cheer of vigour born;
The thoughtless day, the easy night,
The spirits pure, the slumbers light,
That fly the approach of morn.

[1] King Henry VI., founder of the college.

6.

Alas! regardless of their doom,
The little victims play;
No sense have they of ills to come,
Nor care beyond to-day;
Yet see how all around them wait
The ministers of human fate,
And black Misfortune's baleful train.
Ah! shew them where in ambush stand,
To seize their prey, the murth'rous band;
Ah, tell them they are men!

7.

These shall the fury passions tear,
The vultures of the mind—
Disdainful Anger, pallid Fear,
And Shame that skulks behind;
Or pining Love shall waste their youth,
Or Jealousy with rankling tooth,
That inly gnaws the secret heart;
And Envy wan, and faded Care,
Grim-visaged comfortless Despair,
And Sorrow's piercing dart.

8.

Ambition this shall tempt to rise,
Then whirl the wretch from high,
To bitter Scorn a sacrifice,
And grinning Infamy.
The stings of Falsehood those shall try,
And hard Unkindness' altered eye,
That mocks the tear it forced to flow:
And keen Remorse with blood defiled,
And moody Madness laughing wild,
Amid severest woe.

9.

Lo! in the vale of years beneath
A grisly troop are seen,
The painful family of Death,
More hideous than their queen:
This racks the joints, this fires the veins,
That every labouring sinew strains,
Those in the deeper vitals rage:
Lo! Poverty, to fill the band,
That numbs the soul with icy hand,
And slow-consuming Age.

10.

To each his sufferings: all are men,
Condemned alike to groan;
The tender for another's pain,
The unfeeling for his own.
Yet, ah! why should they know their fate,
Since sorrow never comes too late,
And happiness too swiftly flies?
Thought would destroy their paradise.
No more; where ignorance is bliss,
'Tis folly to be wise.

[2] Margin.

Oliver Goldsmith: 1728–1774.

From 'The Deserted Village.'

The Village.

Sweet Auburn! loveliest village of the plain,
Where health and plenty cheered the labouring swain;
Where smiling Spring its earliest visit paid,
And parting Summer's lingering blooms delayed:
Dear lovely bowers of innocence and ease,
Seats of my youth, when every sport could please;
How often have I loitered o'er thy green,
Where humble happiness endeared each scene!
How often have I paused on every charm:
The sheltered cot, the cultivated farm,
The never-failing brook, the busy mill,
The decent church that topped the neighbouring hill;
The hawthorn bush, with seats beneath the shade,
For talking age and whispering lovers made!
How often have I blessed the coming day,
When toil, remitting, lent its turn to play,
And all the village train, from labour free,
Led up their sports beneath the spreading tree!
While many a pastime circled in the shade,
The young contending as the old surveyed;
And many a gambol frolicked o'er the ground,
And sleights of art and feats of strength went round;
And still as each repeated pleasure tired,
Succeeding sports the mirthful band inspired—
The dancing pair that simply sought renown,
By holding out to tire each other down;
The swain mistrustless of his smutted face,
While secret laughter tittered round the place;
The bashful virgin's side-long looks of love;
The matron's glance, that would those looks reprove:
These were thy charms, sweet village: sports like these,
With sweet succession, taught even toil to please;
These round thy bowers their cheerful influence shed,
These were thy charms—but all these charms are fled.
Sweet smiling village, loveliest of the lawn,
Thy sports are fled, and all thy charms withdrawn;
Amidst thy bowers the tyrant's hand is seen,
And Desolation saddens all thy green:
One only master grasps the whole domain,
And half a tillage stints thy smiling plain;
No more thy glassy brook reflects the day,
But, choked with sedges, works its weedy way;
Along thy glades, a solitary guest,
The hollow-sounding bittern guards its nest;
Amidst thy desert walks the lapwing flies,
And tires their echoes with unvaried cries:
Sunk are thy bowers in shapeless ruin all,
And the long grass o'ertops the mouldering wall;
And, trembling, shrinking from the spoiler's hand,
Far, far away thy children leave the land.

Ill fares the land, to hastening ills a prey,
Where wealth accumulates, and men decay.
Princes and lords may flourish, or may fade:
A breath can make them, as a breath has made;
But a bold peasantry, their country's pride,
When once destroyed, can never be supplied. . . . .
Sweet was the sound, when oft, at evening's close,
Up yonder hill the village murmur rose;
There, as I passed with careless steps and slow,
The mingling notes came softened from below:
The swain responsive as the milkmaid sung;
The sober herd that lowed to meet their young;
The noisy geese that gabbled o'er the pool;
The playful children just let loose from school;
The watch-dog's voice that bayed the whispering wind;
And the loud laugh that spoke the vacant mind:
These all in sweet confusion sought the shade,
And filled each pause the nightingale had made.
But now the sounds of population fail,
No cheerful murmurs fluctuate in the gale,
No busy steps the grass-grown footway tread,
But all the blooming flush of life is fled:
All but yon widowed, solitary thing,
That feebly bends beside the plashy spring;
She, wretched matron, forced, in age, for bread,
To strip the brook with mantling cresses spread,
To pick her wintry fagot from the thorn,
To seek her nightly shed, and weep till morn;
She only left of all the harmless train,
The sad historian of the pensive plain.

The Village Parson.

Near yonder copse, where once the garden smiled,
And still where many a garden-flower grows wild,
There, where a few torn shrubs the place disclose,
The village preacher's modest mansion rose.
A man he was to all the country dear,
And passing rich with forty pounds a year;
Remote from towns he ran his godly race,
Nor e'er had changed, nor wished to change, his place;
Unskilful he to fawn, or seek for power
By doctrines fashioned to the varying hour;
Far other aims his heart had learned to prize,
More bent to raise the wretched than to rise.
His house was known to all the vagrant train,
He chid their wanderings, but relieved their pain:
The long-remembered beggar was his guest,
Whose beard descending swept his aged breast;
The ruined spendthrift, now no longer proud,
Claimed kindred there, and had his claims allowed;
The broken soldier, kindly bid to stay,
Sat by his fire, and talked the night away;
Wept o'er his wounds, or tales of sorrow done,
Shouldered his crutch, and shewed how fields were won.
Pleased with his guests, the good man learned to glow,
And quite forgot their vices in their woe;

Careless their merits or their faults to scan,
His pity gave ere charity began.
  Thus to relieve the wretched was his pride,
And even his failings leaned to virtue's side;
But in his duty prompt at every call,
He watched and wept, he prayed and felt, for all:
And, as a bird each fond endearment tries,
To tempt its new-fledged offspring to the skies,
He tried each art, reproved each dull delay,
Allured to brighter worlds, and led the way.
  Beside the bed where parting life was laid,
And sorrow, guilt, and pain by turns dismayed,
The reverend champion stood. At his control,
Despair and anguish fled the struggling soul;
Comfort came down the trembling wretch to raise,
And his last faltering accents whispered praise.
  At church, with meek and unaffected grace,
His looks adorned the venerable place;
Truth from his lips prevailed with double sway,
And fools, who came to scoff, remained to pray.
The service past, around the pious man,
With steady zeal, each honest rustic ran;
Even children followed, with endearing wile,
And plucked his gown, to share the good man's smile:
His ready smile a parent's warmth expressed;
Their welfare pleased him, and their cares distressed:
To them his heart, his love, his griefs were given,
But all his serious thoughts had rest in heaven.
As some tall cliff that lifts its awful form,
Swells from the vale, and midway leaves the storm,
Though round its breast the rolling clouds are spread,
Eternal sunshine settles on its head. . . . .

The Poor compelled to Emigrate.

  To distant climes, a dreary scene,
Where half the convex world intrudes between,
Through torrid tracts with fainting steps they go,
Where wild Altama murmurs to their woe.
Far different there from all that charmed before,
The various terrors of that horrid shore;
Those blazing suns that dart a downward ray,
And fiercely shed intolerable day;
Those matted woods where birds forget to sing,
But silent bats in drowsy clusters cling;
Those poisonous fields, with rank luxuriance crowned,
Where the dark scorpion gathers death around;
Where at each step the stranger fears to wake
The rattling terrors of the vengeful snake;
Where crouching tigers wait their hapless prey,
And savage men more murderous still than they:
While oft in whirls the mad tornado flies,
Mingling the ravaged landscape with the skies.
Far different these from every former scene,
The cooling brook, the grassy-vested green,
The breezy covert of the warbling grove,
That only sheltered thefts of harmless love.

James Beattie: 1735–1803.

The Hermit.

1.

At the close of the day, when the hamlet is still,
And mortals the sweets of forgetfulness prove,
When nought but the torrent is heard on the hill,
And nought but the nightingale's song in the grove:
'Twas thus, by the cave of the mountain afar,
While his harp rung symphonious, a hermit began:
No more with himself or with nature at war,
He thought as a sage, though he felt as a man.

2.

'Ah! why, all abandoned to darkness and woe,
Why, lone Philomela, that languishing fall?
For spring shall return, and a lover bestow,
And sorrow no longer thy bosom inthral:
But, if pity inspire thee, renew the sad lay,
Mourn, sweetest complainer, man calls thee to mourn;
O soothe him, whose pleasures like thine pass away:
Full quickly they pass—but they never return.

3.

'Now gliding remote on the verge of the sky,
The moon half extinguished her crescent displays:
But lately I marked, when majestic on high
She shone, and the planets were lost in her blaze.
Roll on, thou fair orb, and with gladness pursue
The path that conducts thee to splendour again;
But man's faded glory what change shall renew?
Ah, fool! to exult in a glory so vain!

4.

''Tis night, and the landscape is lovely no more;
I mourn, but, ye woodlands, I mourn not for you;
For morn is approaching, your charms to restore,
Perfumed with fresh fragrance, and glittering with dew:
Nor yet for the ravage of winter I mourn;
Kind Nature the embryo blossom will save.
But when shall spring visit the mouldering urn—
O when shall it dawn on the night of the grave?

5.

'Twas thus, by the glare of false science betrayed,
That leads, to bewilder; and dazzles, to blind;
My thoughts wont to roam, from shade onward to shade,
Destruction before me, and sorrow behind.
"O pity, great Father of Light," then I cried,
"Thy creature, who fain would not wander from thee;
Lo, humbled in dust, I relinquish my pride:
From doubt and from darkness thou only canst free!"

6.

'And darkness and doubt are now flying away,
No longer I roam in conjecture forlorn.
So breaks on the traveller, faint, and astray,
The bright and the balmy effulgence of morn.
See Truth, Love, and Mercy in triumph descending,
And Nature all glowing in Eden's first bloom!
On the cold cheek of death, smiles and roses are blending,
And beauty immortal awakes from the tomb.'

William Cowper: 1731–1800.

From The Task.

Nature's Works.

Like a coy maiden, Ease, when courted most,
Farthest retires—an idol, at whose shrine
Who oftenest sacrifice are favoured least.
The love of Nature, and the scenes she draws,
Is Nature's dictate. Strange! there should be found
Who, self-imprisoned in their proud saloons,
Renounce the odours of the open field
For the unscented fictions of the loom;
Who, satisfied with only pencilled scenes,
Prefer to the performance of a God
The inferior wonders of an artist's hand!
Lovely indeed the mimic works of art;
But Nature's works far lovelier. I admire,
None more admires, the painter's magic skill,
Who shews me that which I shall never see,
Conveys a distant country into mine,
And throws Italian light on English walls:
But imitative strokes can do no more
Than please the eye—sweet Nature every sense.
The air salubrious of her lofty hills,
The cheering fragrance of her dewy vales,
And music of her woods—no works of man
May rival these; these all bespeak a power
Peculiar, and exclusively her own.
Beneath the open sky she spreads the feast;
'Tis free to all—'tis every day renewed;
Who scorns it, starves deservedly at home.
He does not scorn it who, imprisoned long
In some unwholesome dungeon, and a prey
To sallow sickness, which the vapours, dank
And clammy, of his dark abode have bred,
Escapes at last to liberty and light:
His cheek recovers soon its healthful hue;
His eye relumines its extinguished fires;
He walks, he leaps, he runs—is winged with joy,
And riots in the sweets of every breeze.
He does not scorn it who has long endured
A fever's agonies, and fed on drugs;
Nor yet the mariner, his blood inflamed
With acrid salts, his very heart athirst
To gaze at Nature in her green array;
Upon the ship's tall side he stands, possessed
With visions prompted by intense desire:
Fair fields appear below, such as he left
Far distant, such as he would die to find—
He seeks them headlong, and is seen no more.

Christian Patriotism.

Patriots have toiled, and in their country's cause
Bled nobly, and their deeds, as they deserve,
Receive proud recompense. We give in charge
Their names to the sweet lyre. The historic Muse,
Proud of the treasure, marches with it down
To latest times; and Sculpture, in her turn,
Gives bond in stone and ever-during brass,
To guard them, and to immortalise her trust.
But fairer wreaths are due, though never paid,
To those who, posted at the shrine of truth,
Have fallen in her defence. A patriot's blood
Well spent in such a strife may earn indeed,
And for a time insure to his loved land
The sweets of liberty and equal laws;
But martyrs struggle for a brighter prize,
And win it with more pain. Their blood is shed
In confirmation of the noblest claim,
Our claim to feed upon immortal truth,
To walk with God, to be divinely free,
To soar, and to anticipate the skies!
Yet few remember them. They lived unknown
Till persecution dragged them into fame,
And chased them up to heaven. Their ashes flew—
No marble tells us whither. With their names
No bard embalms and sanctifies his song,
And History, so warm on meaner themes,
Is cold on this. She execrates indeed
The tyranny that doomed them to the fire,
But gives the glorious sufferers little praise.

He is the freeman whom the truth makes free,
And all are slaves beside. There's not a chain
That hellish foes confederate for his harm
Can wind around him, but he casts it off
With as much ease as Samson his green withes.
He looks abroad into the varied field
Of Nature, and, though poor perhaps compared
With those whose mansions glitter in his sight,
Calls the delightful scenery all his own.
His are the mountains, and the valleys his,
And the resplendent rivers. His to enjoy
With a propriety that none can feel,
But who, with filial confidence inspired,
Can lift to heaven an unpresumptuous eye,
And smiling say—My Father made them all!
Are they not his by a peculiar right,
And by an emphasis of interest his,
Whose eye they fill with tears of holy joy,
Whose heart with praise, and whose exalted mind
With worthy thoughts of that unwearied love

That planned, and built, and still upholds a world
So clothed with beauty, for rebellious man?
Yes—ye may fill your garners, ye that reap
The loaded soil, and ye may waste much good
In senseless riot; but ye will not find
In feast or in the chase, in song or dance
A liberty like his, who, unimpeached
Of usurpation, and to no man's wrong,
Appropriates nature as his Father's work,
And has a richer use of yours, than you.
He is indeed a freeman. Free by birth
Of no mean city, planned or ere the hills
Were built, the fountains opened, or the sea
With all his roaring multitude of waves.
His freedom is the same in every state;
And no condition of this changeful life
So manifold in cares, whose every day
Brings its own evil with it, makes it less.
For he has wings that neither sickness, pain,
Nor penury, can cripple or confine.
No nook so narrow but he spreads them there
With ease, and is at large. The oppressor holds
His body bound, but knows not what a range
His spirit takes, unconscious of a chain;
And that to bind him is a vain attempt,
Whom God delights in, and in whom he dwells.

The Play-place of Early Days.—From 'Tirocinium, or a Review of Schools.'

Be it a weakness, it deserves some praise,
We love the play-place of our early days;
The scene is touching, and the heart is stone
That feels not at that sight, and feels at none.
The wall on which we tried our graving skill,
The very name we carved subsisting still;
The bench on which we sat while deep employed,
Though mangled, hacked, and hewed, not yet destroyed;
The little ones, unbuttoned, glowing hot,
Playing our games, and on the very spot;
As happy as we once, to kneel and draw
The chalky ring, and knuckle down at taw;
To pitch the ball into the grounded hat,
Or drive it devious with a dexterous pat:
The pleasing spectacle at once excites
Such recollection of our own delights,
That, viewing it, we seem almost to obtain
Our innocent sweet simple years again.
This fond attachment to the well-known place,
Whence first we started into life's long race,
Maintains its hold with such unfailing sway,
We feel it even in age, and at our latest day.

Robert Burns: 1759—1796.

To a Mountain Daisy,

On turning one down with the plough in April 1786.

1.

Wee, modest, crimson-tipped flower,
Thou's met me in an evil hour;
For I maun crush amang the stoure[1]
Thy slender stem:
To spare thee now is past my power,
Thou bonnie gem.

2.

Alas! it's no thy neibor[2] sweet,
The bonnie lark, companion meet,
Bending thee 'mang the dewy weet,[3]
Wi' spreckled[4] breast,
When upward-springing, blithe, to greet
The purpling east!

3.

Cauld[5] blew the bitter-biting north
Upon thy early, humble birth;
Yet cheerfully thou glinted[6] forth
Amid the storm,
Scarce reared above the parent earth
Thy tender form.

4.

The flaunting flowers our gardens yield,
High sheltering woods and wa's maun[7] shield:
But thou, beneath the random bield[8]
O' clod or stane,
Adorns the histie stibble-field,[9]
Unseen, alane.

5.

There in thy scanty mantle clad,
Thy snawie bosom sunward spread,
Thou lifts thy unassuming head
In humble guise;
But now the share uptears thy bed,
And low thou lies! . . . .

6.

Such fate to suffering worth is given,
Who long with wants and woes has striven,
By human pride or cunning driven
To misery's brink,
Till wrenched of every stay but Heaven,
He, ruined, sink!

7.

Even thou who mourn'st the daisy's fate,
That fate is thine—no distant date;
Stern Ruin's ploughshare drives, elate,
Full on thy bloom,
Till crushed beneath the furrow's weight,
Shall be thy doom.

1 Dust. 2 Neighbour. 3 Wetness. 4 Speckled. 5 Cold. 6 Peeped. 7 Walls must. 8 Shelter. 9 Dry stubble-field.

Bonnie Doon.

1.

Ye flowery banks o' bonnie Doon,
How can ye bloom sae fair?
How can ye chant, ye little birds,
And I sae fu' o' care?

2.

Thou'll break my heart, thou bonnie bird,
That sings upon the bough;
Thou minds me o' the happy days
When my fause[1] luve was true.

3.

Thou 'll break my heart, thou bonnie bird,
That sings beside thy mate;
For sae I sat, and sae I sang,
And wist na o' my fate.

4.

Aft hae I roved by bonnie Doon,
To see the woodbine twine,
And ilka[2] bird sang o' its love:
And sae did I o' mine.

5.

Wi' lightsome heart I pu'd a rose
Frae aff[3] its thorny tree;
And my fause luver staw[4] the rose,
But left the thorn wi' me.

Bruce's Address.

1.

Scots, wha hae wi' Wallace bled,
Scots, wham Bruce has aften led;
Welcome to your gory bed,
Or to victory!

2.

Now 's the day, and now 's the hour;
See the front o' battle lour;
See approach proud Edward's power—
Chains and slavery!

3.

Wha will be a traitor knave?
Wha can fill a coward's grave?
Wha sae base as be a slave?
Let him turn and flee!

4.

Wha for Scotland's king and law
Freedom's sword will strongly draw,
Freeman stand, or freeman fa',
Let him follow me!

5.

By oppression's woes and pains!
By your sons in servile chains!
We will drain our dearest veins,
But they shall be free!

6.

Lay the proud usurpers low!
Tyrants fall in every foe!
Liberty 's in every blow!
Let us do, or die!

1 False. 2 Each. 3 From off. 4 Stole.

George Crabbe: 1754–1832.

A Cottage.—From 'The Parish Register.'

Behold the cot! where thrives the industrious swain,
Source of his pride, his pleasure, and his gain;
Screened from the winter's wind, the sun's last ray
Smiles on the window, and prolongs the day;
Projecting thatch the woodbine's branches stop,
And turn their blossoms to the casement's top:—
All need requires is in that cot contained,
And much that taste, untaught and unrestrained,
Surveys delighted; there she loves to trace,
In one gay picture, all the royal race;
Around the walls are heroes, lovers, kings;
The print that shews them, and the verse that sings.

* * * *

On shelf of deal beside the cuckoo-clock,
Of cottage-reading rests the chosen stock;
Learning we lack, not books, but have a kind
For all our wants, a meat for every mind:
The tale for wonder, and the joke for whim,
The half-sung sermon, and the half-groaned hymn.

No need of classing; each within its place,
The feeling finger in the dark can trace;
'First from the corner, farthest from the wall;'
Such all the rules, and they suffice for all.

There pious works for Sunday's use are found,
Companions for that Bible newly bound;
That Bible, bought by sixpence weekly saved,
Has choicest prints by famous hands engraved;
Has choicest notes by many a famous head,
Such as to doubt have rustic readers led;
Have made them stop to reason *why?* and *how?*
And where they once agreed, to cavil now.
Oh! rather give me commentators plain,
Who with no deep researches vex the brain;
Who from the dark and doubtful love to run,
And hold their glimmering tapers to the sun;
Who simple truth with nine-fold reasons back,
And guard the point no enemies attack.

Bunyan's famed Pilgrim rests that shelf upon:
A genius rare but rude was honest John;
Not one who, early by the muse beguiled,
Drank from her well, the waters undefiled;
Not one who slowly gained the hill sublime,
Then often sipped, and little at a time;
But one who dabbled in the sacred springs,
And drank them muddy, mixed with baser things.

Samuel Rogers: 1763—1855.

Human Life.

The lark has sung his carol in the sky,
The bees have hummed their noontide lullaby;
Still in the vale the village bells ring round,
Still in Llewellyn Hall the jests resound;
For now the caudle-cup is circling there,
Now, glad at heart, the gossips breathe their prayer,
And, crowding, stop the cradle to admire
The babe, the sleeping image of his sire.

A few short years, and then these sounds shall hail
The day again, and gladness fill the vale;
So soon the child a youth, the youth a man,
Eager to run the race his fathers ran.
Then the huge ox shall yield the broad sirloin;
The ale, now brewed, in floods of amber shine;
And, basking in the chimney's ample blaze,
'Mid many a tale told of his boyish days,
The nurse shall cry, of all her ills beguiled:
'"Twas on her knees he sat so oft and smiled.'

And soon again shall music swell the breeze;
Soon, issuing forth, shall glitter through the trees
Vestures of nuptial white; and hymns be sung,
And violets scattered round; and old and young,
In every cottage-porch with garlands green,
Stand still to gaze, and, gazing, bless the scene,
While, her dark eyes declining, by his side,
Moves in her virgin veil the gentle bride.

And once, alas! nor in a distant hour,
Another voice shall come from yonder tower;
When in dim chambers long black weeds are seen,
And weeping heard where only joy has been;
When, by his children borne, and from his door,
Slowly departing to return no more,
He rests in holy earth with them that went before.

And such is human life; so gliding on,
It glimmers like a meteor, and is gone!
Yet is the tale, brief though it be, as strange,
As full, methinks, of wild and wondrous change,
As any that the wandering tribes require,
Stretched in the desert round their evening fire;
As any sung of old, in hall or bower,
To minstrel-harps at midnight's witching hour!

William Wordsworth: 1770–1850.

A Peasant Youth.—From 'The Excursion.'

The mountain ash
No eye can overlook, when 'mid a grove
Of yet unfaded trees she lifts her head
Decked with autumnal berries, that outshine
Spring's richest blossoms; and ye may have marked
By a brook-side or solitary tarn,
How she her station doth adorn. The pool
Glows at her feet, and all the gloomy rocks
Are brightened round her. In his native vale,
Such and so glorious did this youth appear;
A sight that kindled pleasure in all hearts
By his ingenuous beauty, by the gleam
Of his fair eyes, by his capacious brow,
By all the graces with which nature's hand
Had lavishly arrayed him. As old bards
Tell in their idle songs of wandering gods,
Pan or Apollo, veiled in human form;
Yet, like the sweet-breathed violet of the shade,
Discovered in their own despite to sense
Of mortals—if such fables without blame
May find chance mention on this sacred ground—
So, through a simple rustic garb's disguise,
And through the impediment of rural cares,
In him revealed a scholar's genius shone;
And so, not wholly hidden from men's sight,
In him the spirit of a hero walked
Our unpretending valley. How the quoit
Whizzed from the stripling's arm! If touched by him,
The inglorious football mounted to the pitch
Of the lark's flight, or shaped a rainbow curve,
Aloft, in prospect of the shouting field!
The indefatigable fox had learned
To dread his perseverance in the chase.
With admiration would he lift his eyes
To the wide-ruling eagle, and his hand
Was loath to assault the majesty he loved,
Else had the strongest fastnesses proved weak
To guard the royal brood. The sailing glede,
The wheeling swallow, and the darting snipe,
The sporting sea-gull dancing with the waves,
And cautious waterfowl, from distant climes,
Fixed at their seat, the centre of the mere,
Were subject to young Oswald's steady aim,
And lived by his forbearance.

Yarrow Visited.—September 1814.

1.

And is this—Yarrow?—*This* the stream
Of which my fancy cherished,
So faithfully, a waking dream?
An image that hath perished!
O that some minstrel's harp were near,
To utter notes of gladness,
And chase this silence from the air,
That fills my heart with sadness!

2.

Yet why?—a silvery current flows
With uncontrolled meanderings;
Nor have these eyes by greener hills
Been soothed, in all my wanderings.
And, through her depths, Saint Mary's Lake
Is visibly delighted;
For not a feature of those hills
Is in the mirror slighted.

3.

A blue sky bends o'er Yarrow Vale,
Save where that pearly whiteness
Is round the rising sun diffused,
A tender hazy brightness;
Mild dawn of promise! that excludes
All profitless dejection;
Though not unwilling here to admit
A pensive recollection.

4.

Where was it that the famous Flower
Of Yarrow Vale lay bleeding?
His bed perchance was yon smooth mound
On which the herd is feeding:
And haply from this crystal pool,
Now peaceful as the morning,
The water-wraith[1] ascended thrice—
And gave his doleful warning.

5.

Delicious is the lay that sings
The haunts of happy lovers,
The path that leads them to the grove,
The leafy grove that covers:
And pity sanctifies the verse
That paints, by strength of sorrow,
The unconquerable strength of love;
Bear witness, rueful Yarrow!

6.

But thou, that didst appear so fair
To fond imagination,
Dost rival in the light of day
Her delicate creation:
Meek loveliness is round thee spread,
A softness still and holy;
The grace of forest-charms decayed,
And pastoral melancholy.

7.

That region left, the vale unfolds
Rich groves of lofty stature,
With Yarrow winding through the pomp
Of cultivated nature;
And, rising from those lofty groves,
Behold a ruin hoary!
The shattered front of Newark's Towers,
Renowned in Border story.

8.

Fair scenes for childhood's opening bloom,
For sportive youth to stray in!
For manhood to enjoy his strength;
And age to wear away in!
Yon cottage seems a bower of bliss;
It promises protection
To studious ease and generous cares,
And every chaste affection!

9.

How sweet on this autumnal day,
The wild wood's fruits to gather,
And on my true-love's forehead plant
A crest of blooming heather!
And what if I enwreathed my own!
'Twere no offence to reason;
The sober hills thus deck their brows
To meet the wintry season.

10.

I see—but not by sight alone,
Loved Yarrow, have I won thee;
A ray of fancy still survives—
Her sunshine plays upon thee!
Thy ever-youthful waters keep
A course of lively pleasure;
And gladsome notes my lips can breathe,
Accordant to the measure.

11.

The vapours linger round the heights,
They melt—and soon must vanish;
One hour is theirs, nor more is mine—
Sad thought! which I would banish,
But that I know, where'er I go,
Thy genuine image, Yarrow!
Will dwell with me—to heighten joy,
And cheer my mind in sorrow.

[1] An apparition of a person in his exact likeness, supposed to be seen before his death or shortly after.

To the Daisy.

1.
With little here to do or see
Of things that in the great world be,
Sweet Daisy! oft I talk to thee,
For thou art worthy,
Thou unassuming commonplace
Of Nature, with that homely face,
And yet with something of a grace,
Which love makes for thee!

2.
Oft do I sit by thee at ease,
And weave a web of similes,
Loose types of things through all degrees,
Thoughts of thy raising:
And many a fond and idle name
I give to thee, for praise or blame,
As is the humour of the game,
While I am gazing.

3.
A nun demure, of lowly port;
Or sprightly maiden, of love's court,
In thy simplicity the sport
Of all temptations;
A queen in crown of rubies drest;
A starveling in a scanty vest;
Are all, as seem to suit thee best,
Thy appellations.

4.
A little Cyclops, with one eye
Staring to threaten and defy,
That thought comes next—and instantly
The freak is over,
The shape will vanish, and behold!
A silver shield with boss of gold,
That spreads itself, some fairy bold
In fight to cover.

5.
I see thee glittering from afar—
And then thou art a pretty star;
Not quite so fair as many are
In heaven above thee!
Yet like a star, with glittering crest,
Self-poised in air thou seem'st to rest—
May peace come never to his nest,
Who shall reprove thee!

6.
Sweet flower! for by that name at last,
When all my reveries are past,
I call thee, and to that cleave fast,
Sweet silent creature!
That breath'st with me in sun and air,
Do thou, as thou art wont, repair
My heart with gladness, and a share
Of thy meek nature!

The Labourers' Noon-day Hymn.

1.
Up to the throne of God is borne
The voice of praise at early morn;
And He accepts the punctual hymn,
Sung as the light of day grows dim.

2.
Nor will He turn His ear aside
From holy offerings at noon-tide;
Then, here reposing, let us raise
A song of gratitude and praise.

3.
What though our burden be not light,
We need not toil from morn to night;
The respite of the mid-day hour
Is in the thankful creature's power.

4.
Blest are the moments, doubly blest,
That, drawn from this one hour of rest,
Are with a ready heart bestowed
Upon the service of our God!

5.
Each field is then a hallowed spot,
An altar is in each man's cot,
A church in every grove that spreads
Its living roof above our heads.

6.
Look up to heaven! the industrious sun
Already half his race hath run:
He cannot halt nor go astray,
But our immortal spirits may.

7.
Lord! since his rising in the east,
If we have faltered or transgressed,
Guide from thy love's abundant source
What yet remains of this day's course.

8.
Help with thy grace through life's short day,
Our upward and our downward way;
And glorify for us the west,
When we shall sink to final rest.

Lucy.

1.
She dwelt among the untrodden ways
Beside the springs of Dove,
A maid whom there were none to praise,
And very few to love.

2.
A violet by a mossy stone
Half-hidden from the eye!
Fair as a star, when only one
Is shining in the sky.

3.
She lived unknown, and few could know
When Lucy ceased to be;
But she is in her grave, and, oh,
The difference to me!

Expostulation and Reply.

1.

'Why, William, on that old gray stone,
Thus for the length of half a day,
Why, William, sit you thus alone,
And dream your time away?

2.

'Where are your books?—that light bequeathed
To beings else forlorn and blind!
Up! up! and drink the spirit breathed
From dead men to their kind.

3.

'You look round on your mother earth,
As if she for no purpose bore you;
As if you were her first-born birth,
And none had lived before you!'

4.

One morning thus, by Esthwaite Lake,
When life was sweet, I knew not why,
To me my good friend Matthew spake,
And thus I made reply:

5.

'The eye—it cannot choose but see;
We cannot bid the ear be still;
Our bodies feel, where'er they be,
Against, or with our will.

6.

'Nor less I deem that there are powers
Which of themselves our minds impress;
That we can feed this mind of ours
In a wise passiveness.

7.

'Think you, 'mid all this mighty sum
Of things for ever speaking,
That nothing of itself will come,
But we must still be seeking?

8.

'Then ask not wherefore, here, alone,
Conversing as I may,
I sit upon this old gray stone,
And dream my time away.'

The Tables Turned;

AN EVENING SCENE, ON THE SAME SUBJECT.

1.

Up! up! my friend, and clear your looks;
Why all this toil and trouble?
Up! up! my friend, and quit your books,
Or surely you'll grow double.

2.

The sun, above the mountain's head,
A freshening lustre mellow
Through all the long green fields has spread,
His first sweet evening yellow.

3.

Books! 'tis a dull and endless strife:
Come, hear the woodland linnet,
How sweet his music! on my life,
There's more of wisdom in it.

4.

And hark! how blithe the throstle sings!
He, too, is no mean preacher:
Come forth into the light of things,
Let Nature be your teacher.

5.

She has a world of ready wealth,
Our minds and hearts to bless—
Spontaneous wisdom breathed by health,
Truth breathed by cheerfulness.

6.

One impulse from a vernal wood
May teach you more of man,
Of moral evil and of good,
Than all the sages can.

7.

Sweet is the lore which Nature brings;
Our meddling intellect
Mis-shapes the beauteous forms of things:
We murder to dissect.

8.

Enough of science and of art;
Close up these barren leaves;
Come forth, and bring with you a heart
That watches and receives.

To a Butterfly.

1.

Stay near me—do not take thy flight!
A little longer stay in sight!
Much converse do I find in thee,
Historian of my infancy!
Float near me; do not yet depart!
Dead times revive in thee:
Thou bring'st, gay creature as thou art!
A solemn image to my heart,
My father's family!

2.

Oh! pleasant, pleasant were the days,
The time, when in our childish plays,
My sister Emmeline and I
Together chased the Butterfly!
A very hunter did I rush
Upon the prey: with leaps and springs
I followed on from brake to bush;
But she, God love her! feared to brush
The dust from off its wings.

Samuel Taylor Coleridge: 1772–1834.

Hymn before Sunrise in the Vale of Chamouni.

Hast thou a charm to stay the morning-star
In his steep course? So long he seems to pause
On thy bald awful head, O sovran Blanc!
The Arve and Arveiron at thy base
Rave ceaselessly; but thou, most awful Form!
Risest from forth thy silent sea of pines,
How silently! Around thee and above,
Deep is the air and dark, substantial, black,
An ebon mass: methinks thou piercest it,
As with a wedge! But when I look again,
It is thine own calm home, thy crystal shrine,
Thy habitation from eternity!
O dread and silent Mount! I gazed upon thee,
Till thou, still present to the bodily sense,
Didst vanish from my thought: entranced in prayer,
I worshipped the Invisible alone.

Yet, like some sweet beguiling melody,
So sweet we know not we are listening to it,
Thou, the meanwhile, wast blending with my thought,
Yea, with my life and life's own secret joy;
Till the dilating Soul, enrapt, transfused,
Into the mighty vision passing—there,
As in her natural form, swelled vast to Heaven!

Awake, my soul! not only passive praise
Thou owest! not alone these swelling tears,
Mute thanks and secret ecstasy. Awake,
Voice of sweet song! Awake, my Heart, awake!
Green vales and icy cliffs, all join my Hymn.

Thou first and chief, sole sovran of the Vale!
O struggling with the darkness all the night,
And visited all night by troops of stars,
Or when they climb the sky, or when they sink:
Companion of the morning-star at dawn,
Thyself Earth's rosy star, and of the dawn
Co-herald! wake, O wake, and utter praise!
Who sank thy sunless pillars deep in Earth?
Who filled thy countenance with rosy light?
Who made thee parent of perpetual streams?

And you, ye five wild torrents fiercely glad!
Who called you forth from night and utter death,
From dark and icy caverns called you forth,
Down those precipitous, black, jagged rocks,
For ever shattered, and the same for ever?
Who gave you your invulnerable life,
Your strength, your speed, your fury, and your joy,
Unceasing thunder and eternal foam?

And who commanded—and the silence came—
Here let the billows stiffen, and have rest!

Ye ice-falls! ye that from the mountain's brow
Adown enormous ravines slope amain—
Torrents, methinks, that heard a mighty voice,
And stopped at once amid their maddest plunge!
Motionless torrents! silent cataracts!
Who made you glorious as the gates of Heaven
Beneath the keen full moon? Who bade the sun
Clothe you with rainbows? Who, with living flowers
Of loveliest blue, spread garlands at your feet?—
God! let the torrents, like a shout of nations,
Answer! and let the ice-plains echo, God!
God! sing ye meadow-streams with gladsome voice!
Ye pine-groves, with your soft and soul-like sounds!
And they, too, have a voice, yon piles of snow,
And in their perilous fall shall thunder, God!

Ye living flowers that skirt the eternal frost!
Ye wild goats sporting round the eagle's nest!
Ye eagles, playmates of the mountain-storm!
Ye lightnings, the dread arrows of the clouds!
Ye signs and wonders of the element!
Utter forth God, and fill the hills with praise!

Thou too, hoar Mount! with thy sky-pointing peaks,
Oft from whose feet the avalanche, unheard,
Shoots downward, glittering through the pure serene,
Into the depth of clouds that veil thy breast—
Thou too, again, stupendous Mountain! thou,
That as I raise my head, awhile bowed low
In adoration, upward from thy base,
Slow travelling with dim eyes suffused with tears,
Solemnly seemest, like a vapoury cloud,
To rise before me—Rise, O ever rise;
Rise, like a cloud of incense, from the Earth!
Thou kingly Spirit throned among the hills,
Thou dread ambassador from Earth to Heaven,
Great Hierarch! tell thou the silent sky,
And tell the stars, and tell yon rising sun,
Earth, with her thousand voices, praises God.

Epitaph for Himself.

Stop, Christian passer-by! Stop, child of God!
And read with gentle breast. Beneath this sod
A poet lies, or that which once seemed he—
Oh! lift a thought in prayer for S. T. C.!
That he who many a year, with toil of breath,
Found death in life, may here find life in death!
Mercy for praise—to be forgiven for fame,
He asked and hoped through Christ—do thou the same.

Robert Southey: 1774—1843.

The Holly Tree.

1.
O reader! hast thou ever stood to see
The holly tree?
The eye that contemplates it, well perceives
Its glossy leaves
Ordered by an intelligence so wise
As might confound the atheist's sophistries.

2.
Below, a circling fence, its leaves are seen
Wrinkled and keen;
No grazing cattle through their prickly round
Can reach to wound;
But as they grow where nothing is to fear,
Smooth and unarmed the pointless leaves appear.

3.
I love to view these things with curious eyes,
And moralise:
And in this wisdom of the holly tree
Can emblems see
Wherewith perchance to make a pleasant rhyme,
One which may profit in the after-time.

4.
Thus, though abroad perchance I might appear
Harsh and austere,
To those who on my leisure would intrude
Reserved and rude,
Gentle at home amid my friends I'd be
Like the high leaves upon the holly tree.

5.
And should my youth, as youth is apt, I know,
Some harshness shew,
All vain asperities I day by day
Would wear away,
Till the smooth temper of my age should be
Like the high leaves upon the holly tree.

6.
And as when all the summer trees are seen
So bright and green,
The holly leaves a sober hue display
Less bright than they,
But when the bare and wintry woods we see,
What then so cheerful as the holly tree?

7.
So serious should my youth appear among
The thoughtless throng,
So would I seem amid the young and gay
More grave than they,
That in my age as cheerful I might be
As the green winter of the holly tree.

The Source of the Ganges.—From 'The Curse of Kehama.'

None hath seen its secret fountain;
But on the top of Meru mountain
Which rises o'er the hills of earth,
In light and clouds, it hath its mortal birth.
Earth seems that pinnacle to rear
Sublime above this worldly sphere,
Its cradle, and its altar, and its throne;
And there the new-born River lies
Outspread beneath its native skies,
As if it there would love to dwell
Alone and unapproachable.
Soon flowing forward, and resigned
To the will of the Creating Mind,
It springs at once, with sudden leap,
Down from the immeasurable steep.
From rock to rock, with shivering force rebounding,
The mighty cataract rushes; Heaven around,
Like thunder, with the incessant roar resounding,
And Meru's summit shaking with the sound.
Wide spreads the snowy foam, the sparkling spray
Dances aloft; and ever there, at morning,
The earliest sunbeams haste to wing their way,
With rainbow wreaths the holy flood adorning;
And duly the adoring Moon at night
Sheds her white glory there,
And in the watery air
Suspends her halo-crowns of silver light.

A mountain valley in its blessed breast
Receives the stream, which there delights to lie,
Untroubled and at rest,
Beneath the untainted sky.
There in a lovely lake it seems to sleep,
And thence, through many a channel dark and deep,
Their secret way the holy Waters wind.

Opening Stanzas of 'Thalaba.'

How beautiful is night!
A dewy freshness fills the silent air;
No mist obscures, nor cloud, nor speck, nor stain,
Breaks the serene of heaven:
In full-orbed glory, yonder moon divine
Rolls through the dark-blue depths.
Beneath her steady ray
The desert-circle spreads,
Like the round ocean, girdled with the sky.
How beautiful is night!

Who, at this untimely hour,
Wanders o'er the desert sands?
No station is in view,
Nor palm-grove islanded amid the waste.
The mother and her child,

The widowed mother and the fatherless boy,
They, at this untimely hour,
Wander o'er the desert sands.

Alas! the setting sun
Saw Zeinab in her bliss,
Hodeirah's wife beloved,
The fruitful mother late,
Whom, when the daughters of Arabia named,
They wished their lot like hers:
She wanders o'er the desert sands
A wretched widow now,
The fruitful mother of so fair a race;
With only one preserved,
She wanders o'er the wilderness.

No tear relieved the burden of her heart;
Stunned with the heavy woe, she felt like one
Half-wakened from a midnight dream of blood.
But sometimes, when the boy
Would wet her hand with tears,
And, looking up to her fixed countenance,
Sob out the name of Mother, then did she
Utter a feeble groan.
At length, collecting, Zeinab turned her eyes
To heaven, exclaiming: 'Praised be the Lord!
He gave, He takes away!
The Lord our God is good!'

A Moonlight Scene.—From 'Roderick, the Last of the Goths.'

How calmly, gliding through the dark-blue sky,
The midnight moon ascends! Her placid beams,
Through thinly scattered leaves, and boughs grotesque,
Mottle with mazy shades the orchard slope;
Here o'er the chestnut's fretted foliage, gray
And massy, motionless they spread; here shine
Upon the crags, deepening with blacker night
Their chasms; and there the glittering argentry
Ripples and glances on the confluent streams.
A lovelier, purer light than that of day
Rests on the hills; and oh! how awfully,
Into that deep and tranquil firmament,
The summits of Auseva rise serene!
The watchman on the battlements partakes
The stillness of the solemn hour; he feels
The silence of the earth; the endless sound
Of flowing water soothes him; and the stars,
Which in that brightest moonlight well-nigh quenched,
Scarce visible, as in the utmost depth
Of yonder sapphire infinite, are seen,
Draw on with elevating influence
Towards eternity the attempered mind.
Musing on worlds beyond the grave, he stands,
And to the Virgin Mother silently
Breathes forth her hymn of praise.

Thomas Campbell: 1777–1844.

Hohenlinden.

1.
On Linden, when the sun was low,
All bloodless lay the untrodden snow,
And dark as winter was the flow
Of Iser, rolling rapidly:

2.
But Linden saw another sight,
When the drum beat at dead of night,
Commanding fires of death to light
The darkness of her scenery.

3.
By torch and trumpet fast arrayed,
Each horseman drew his battle-blade,
And furious every charger neighed,
To join the dreadful revelry.

4.
Then shook the hills with thunder riven,
Then rushed the steed to battle driven,
And louder than the bolts of heaven,
Far flashed the red artillery.

5.
But redder yet that light shall glow
On Linden's hills of stained snow,
And bloodier yet the torrent flow
Of Iser, rolling rapidly.

6.
'Tis morn, but scarce yon level sun
Can pierce the war-clouds, rolling dun,
Where furious Frank, and fiery Hun,
Shout in their sulphurous canopy.

7.
The combat deepens. On, ye brave,
Who rush to glory, or the grave!
Wave, Munich! all thy banners wave,
And charge with all thy chivalry!

8.
Few, few, shall part where many meet!
The snow shall be their winding-sheet,
And every turf beneath their feet
Shall be a soldier's sepulchre.

To the Rainbow.

1.
Triumphal arch, that fill'st the sky,
When storms prepare to part,
I ask not proud Philosophy
To teach me what thou art—

2.
Still seem, as to my childhood's sight,
A midway station given
For happy spirits to alight
Betwixt the earth and heaven.

3.
Can all that optics teach unfold
Thy form to please me so,
As when I dreamt of gems and gold
Hid in thy radiant bow?

4.
When Science from Creation's face
Enchantment's veil withdraws,
What lovely visions yield their place
To cold material laws!

5.
And yet, fair bow, no fabling dreams,
But words of the Most High,
Have told why first thy robe of beams
Was woven in the sky.

6.
When o'er the green undeluged earth
Heaven's covenant thou didst shine,
How came the world's gray fathers forth
To watch thy sacred sign!

7.
And when its yellow lustre smiled
O'er mountains yet untrod,
Each mother held aloft her child
To bless the bow of God.

8.
Methinks thy jubilee to keep,
The first-made anthem rang
On earth delivered from the deep,
And the first poet sang.

9.
Nor ever shall the Muse's eye
Unraptured greet thy beam:
Theme of primeval prophecy,
Be still the prophet's theme!

10.
The earth to thee her incense yields,
The lark thy welcome sings,
When glittering in the freshened fields
The snowy mushroom springs.

11.
How glorious is thy girdle, cast
O'er mountain, tower, and town,
Or mirrored in the ocean vast,
A thousand fathoms down!

12.
As fresh in yon horizon dark,
As young thy beauties seem
As when the eagle from the ark
First sported in thy beam:

13.
For, faithful to its sacred page,
Heaven still rebuilds thy span,
Nor lets the type grow pale with age
That first spoke peace to man.

Battle of the Baltic.

1
Of Nelson and the North,
Sing the glorious day's renown,
When to battle fierce came forth
All the might of Denmark's crown,
And her arms along the deep proudly shone;
By each gun the lighted brand,
In a bold determined hand,
And the Prince of all the land
Led them on.—

2.
Like leviathans afloat,
Lay their bulwarks on the brine;
While the sign of battle flew
On the lofty British line:
It was ten of April morn by the chime:
As they drifted on their path,
There was silence deep as death;
And the boldest held his breath,
For a time.—

3.
But the might of England flushed
To anticipate the scene;
And her van the fleeter rushed
O'er the deadly space between.
'Hearts of oak!' our captains cried; when each gun
From its adamantine lips
Spread a death-shade round the ships,
Like the hurricane eclipse
Of the sun.

4.
Again! again! again!
And the havoc did not slack,
Till a feeble cheer the Dane
To our cheering sent us back;
Their shots along the deep slowly boom:
Then ceased—and all is wail,
As they strike the shattered sail;
Or, in conflagration pale,
Light the gloom.—

5.
Out spoke the victor then,
As he hailed them o'er the wave:
'Ye are brothers! ye are men!
And we conquer but to save—
So peace instead of death let us bring;
But yield, proud foe, thy fleet,
With the crews, at England's feet,
And make submission meet
To our King.'—

6.
Then Denmark blessed our chief,
That he gave her wounds repose;
And the sounds of joy and grief
From her people wildly rose,
As death withdrew his shades from the day.
While the sun looked smiling bright
O'er a wide and woeful sight,
Where the fires of funeral light
Died away.

7.
Now joy, Old England, raise!
For the tidings of thy might,
By the festal cities' blaze,
Whilst the wine-cup shines in light;
And yet amidst that joy and uproar,
Let us think of them that sleep,
Full many a fathom deep,
By thy wild and stormy steep,
Elsinore!

8.
Brave hearts! to Britain's pride
Once so faithful and so true,
On the deck of fame that died—
With the gallant good Riou;[1]
Soft sigh the winds of Heaven o'er their grave!
While the billow mournful rolls,
And the mermaid's song condoles,
Singing glory to the souls
Of the brave!

Song.

1.
When Napoleon was flying
From the field of Waterloo,
A British soldier dying
To his brother bade adieu.

2.
'And take,' he said, 'this token
To the maid that owns my faith,
With the words that I have spoken
In affection's latest breath.'

3.
Sore mourned the brother's heart,
When the youth beside him fell;
But the trumpet warned to part,
And they took a sad farewell.

4.
There was many a friend to lose him,
For that gallant soldier sighed;
But the maiden of his bosom
Wept when all their tears were dried.

[1] Captain Riou, styled by Lord Nelson the gallant and the good.

Sir Walter Scott: 1771–1832.

Visit of William of Deloraine to Melrose Abbey.—From 'The Lay of the Last Minstrel.'

1.

Short halt did Deloraine make there;
Little recked he of the scene so fair.
With dagger's hilt, on the wicket strong,
He struck full loud, and struck full long.
The porter hurried to the gate—
'Who knocks so loud, and knocks so late?'
'From Branksome I,' the Warrior cried;
And straight the wicket opened wide:
For Branksome's chiefs had in battle stood,
To fence the rights of fair Melrose;
And lands and livings, many a rood,
Had gifted the shrine for their souls' repose.

2.

Bold Deloraine his errand said;
The porter bent his humble head;
With torch in hand, and feet unshod,
And noiseless step, the path he trod;
The arched cloisters, far and wide,
Rang to the Warrior's clanking stride;
Till, stooping low his lofty crest,
He entered the cell of the ancient priest,
And lifted his barred *aventayle*, *visor of the helmet*
To hail the Monk of St Mary's aisle.

3.

'The Ladye of Branksome greets thee by me;
Says, that the fated hour is come,
And that to-night I shall watch with thee,
To win the treasure of the tomb.'
From sackcloth couch the Monk arose,
With toil his stiffened limbs he reared;
A hundred years had flung their snows
On his thin locks and floating beard.

4.

And strangely on the Knight looked he,
And his blue eyes gleamed wild and wide:
'And dar'st thou, Warrior! seek to see
What heaven and hell alike would hide;
My breast, in belt of iron pent,
With shirt of hair and scourge of thorn;
For threescore years, in penance spent,
My knees those flinty stones have worn;
Yet all too little to atone
For knowing what should ne'er be known.
Would'st thou thy every future year
In ceaseless prayer and penance *drie*, *endure*
Yet wait thy latter end with fear—
Then, daring Warrior, follow me!' . . . .

5.

Again on the Knight look'd the Churchman old,
And again he sighed heavily;
For he had himself been a warrior bold,
And fought in Spain and Italy;
And he thought on the days that were long since by,
When his limbs were strong, and his courage was high:
Now, slow and faint, he led the way,
Where, cloistered round, the garden lay;
The pillared arches were over their head,
And beneath their feet were the bones of the dead.

6.

Spreading herbs, and flowerets bright,
Glistened with the dew of night;
Nor herb, nor floweret, glistened there,
But was carved in the cloister-arches as fair.
The Monk gazed long on the lovely moon,
Then into the night he looked forth;
And red and bright the streamers light
Were dancing in the glowing north.
So had he seen, in fair Castile,
The youth in glittering squadrons start;
Sudden the flying jennet wheel,
And hurl the unexpected dart.
He knew, by the streamers that shot so bright,
That spirits were riding the northern light.

7.

By a steel-clenched postern door,
They entered now the chancel tall;
The darkened roof rose high aloof
On pillars lofty, and light, and small;
The keystone, that locked each ribbed aisle,
Was a fleur-de-lys,[1] or a quatre-feuille;[2]
The corbells[3] were carved grotesque and grim;
And the pillars, with clustered shafts so trim,
With base and with capital flourished around,
Seemed bundles of lances which garlands had bound. . . .

8.

The moon on the east oriel shone,
Through slender shafts of shapely stone,
By foliaged tracery combined;
Thou would'st have thought some fairy's hand,
'Twixt poplars straight, the osier wand,
In many a freakish knot, had twined;
Then framed a spell, when the work was done,
And changed the willow-wreaths to stone.
The silver light, so pale and faint,
Shewed many a prophet, and many a saint,
Whose image on the glass was dyed;

1 'Flower of the lily,' the royal insignia of France.
2 'Quarter-foil,' a figure disposed in four segments of circles, supposed to resemble an expanded flower of four petals.
3 The projections from which the arches spring.

Full in the midst, his Cross of Red
Triumphant Michael brandished,
And trampled the Apostate's pride.
The moonbeam kissed the holy pane,
And threw on the pavement a bloody stain.

9.

They sate them down on a marble stone
(A Scottish monarch slept below);
Thus spoke the Monk, in solemn tone:
'I was not always a man of woe;
For *Paynim* countries I have trod, *Pagan*
And fought beneath the Cross of God;
Now, strange to my eyes thine arms appear,
And their iron clang sounds strange to my ear.

10.

'In these far climes, it was my lot
To meet the wondrous Michael Scott,
A wizard of such dreaded fame,
That when, in Salamanca's cave,
Him listed his magic wand to wave,
The bells would ring in Notre-Dame!
Some of his skill he taught to me;
And, Warrior, I could say to thee
The words that cleft Eildon Hills in three,
And bridled the Tweed with a curb of stone:
But to speak them were a deadly sin;
And for having but thought them my heart within,
A treble penance must be done.

11.

'When Michael lay on his dying bed,
His conscience was awakened;
He bethought him of his sinful deed,
And he gave me a sign to come with speed:
I was in Spain when the morning rose,
But I stood by his bed ere evening close.
The words may not again be said,
That he spoke to me, on death-bed laid;
They would rend this Abbaye's massy nave,
And pile it in heaps above his grave.

12.

'I swore to bury his Mighty Book,
That never mortal might therein look;
And never to tell where it was hid,
Save at his chief of Branksome's need;
And when that need was past and o'er,
Again the volume to restore.
I buried him on St Michael's night,
When the bell tolled one, and the moon was bright;
And I dug his chamber among the dead,
When the floor of the chancel was stained red,
That his patron's Cross might over him wave,
And scare the fiends from the Wizard's grave.

13.

'It was a night of woe and dread,
When Michael in the tomb I laid;

Strange sounds along the chancel passed,
The banners waved without a blast'—
Still spoke the Monk, when the bell tolled one!—
I tell you, that a braver man
Than William of Deloraine, good at need,
Against a foe ne'er spurred a steed;
Yet somewhat was he chilled with dread,
And his hair did bristle upon his head.

14.

'Lo, Warrior! now, the Cross of Red
Points to the grave of the mighty dead;
Within it burns a wondrous light,
To chase the spirits that love the night:
That lamp shall burn unquenchably,
Until the eternal doom shall be.'
Slow moved the Monk to the broad flagstone,
Which the bloody Cross was traced upon:
He pointed to a secret nook;
An iron bar the Warrior took;
And the Monk made a sign with his withered hand,
The grave's huge portal to expand.

15.

With beating heart to the task he went:
His sinewy frame o'er the grave-stone bent;
With bar of iron heaved amain,
Till the toil-drops fell from his brows like rain.
It was by dint of passing strength,
That he moved the massy stone at length.
I would you had been there, to see
How the light broke forth so gloriously,
Streamed upward to the chancel roof,
And through the galleries far aloof!
No earthly flame blazed e'er so bright:
It shone like heaven's own blessed light;
And, issuing from the tomb,
Shewed the Monk's cowl, and visage pale,
Danced on the dark-browed Warrior's mail,
And kissed his waving plume.

16.

Before their eyes the Wizard lay,
As if he had not been dead a day.
His hoary beard in silver rolled,
He seemed some seventy winters old;
A palmer's amice wrapped him round,
With a wrought Spanish baldric bound,
Like a pilgrim from beyond the sea:
His left hand held his Book of Might;
A silver cross was in his right;
The lamp was placed beside his knee:
High and majestic was his look,
At which the fellest fiends had shook,
And all unruffled was his face:
They trusted his soul had gotten grace.

17.

Often had William of Deloraine
Rode through the battle's bloody plain,
And trampled down the warriors slain,
And neither known remorse nor awe;
Yet now remorse and awe he owned;
His breath came thick, his head swam round,
When this strange scene of death he saw.
Bewildered and unnerved he stood,
And the priest prayed fervently and loud:
With eyes averted prayed he;
He might not endure the sight to see,
Of the man he had loved so brotherly.

18.

And when the Priest his death-prayer had prayed,
Thus unto Deloraine he said:
'Now speed thee what thou hast to do,
Or, Warrior, we may dearly rue;
For those thou mayest not look upon
Are gathering fast round the yawning stone!'
Then Deloraine, in terror, took
From the cold hand the Mighty Book,
With iron clasped, and with iron bound:
He thought, as he took it, the dead man frowned;
But the glare of the sepulchral light,
Perchance, had dazzled the Warrior's sight.

19.

When the huge stone sunk o'er the tomb,
The night returned in double gloom;
For the moon had gone down, and the stars were few;
And, as the Knight and Priest withdrew,
With wavering steps and dizzy brain,
They hardly might the postern gain.
'Tis said, as through the aisles they passed,
They heard strange noises on the blast;
And through the cloister-galleries small,
Which at mid-height thread the chancel wall,
Loud sobs, and laughter louder, ran,
And voices unlike the voice of man;
As if the fiends kept holiday,
Because these spells were brought to day.
I cannot tell how the truth may be;
I say the tale as 'twas said to me.

20.

'Now, hie thee hence,' the Father said;
'And, when we are on death-bed laid,
O may our dear Ladye, and sweet St John,
Forgive our souls for the deed we have done!'
The Monk returned him to his cell,
And many a prayer and penance sped:
When the convent met at the noontide bell—
The Monk of St Mary's aisle was dead!
Before the cross was the body laid,
With hands clasped fast, as if still he prayed.

Lord Byron: 1788–1824.

Apostrophe to the Ocean.—From 'Childe Harold's Pilgrimage.'

1.

Roll on, thou deep and dark-blue Ocean—roll!
Ten thousand fleets sweep over thee in vain;
Man marks the earth with ruin—his control
Stops with the shore; upon the watery plain
The wrecks are all thy deed, nor doth remain
A shadow of man's ravage, save his own,
When, for a moment, like a drop of rain,
He sinks into thy depths with bubbling groan,
Without a grave, unknelled, uncoffined, and unknown.

2.

His steps are not upon thy paths—thy fields
Are not a spoil for him—thou dost arise
And shake him from thee; the vile strength he wields
For earth's destruction thou dost all despise,
Spurning him from thy bosom to the skies,
And send'st him, shivering in thy playful spray
And howling, to his gods, where haply lies
His petty hope in some near port or bay,
And dashest him again to earth:—there let him lay.

3.

The armaments which thunderstrike the walls
Of rock-built cities, bidding nations quake,
And monarchs tremble in their capitals,
The oak leviathans, whose huge ribs make
Their clay creator the vain title take
Of lord of thee, and arbiter of war—
These are thy toys, and, as the snowy flake,
They melt into thy yeast of waves, which mar
Alike the Armada's pride or spoils of Trafalgar.

4.

Thy shores are empires, changed in all save thee—
Assyria, Greece, Rome, Carthage, what are they?
Thy waters washed them power while they were free,
And many a tyrant since; their shores obey
The stranger, slave, or savage; their decay
Has dried up realms to deserts: not so thou—
Unchangeable, save to thy wild waves' play,
Time writes no wrinkle on thine azure brow;
Such as creation's dawn beheld, thou rollest now.

5.

Thou glorious mirror, where the Almighty's form
Glasses itself in tempests; in all time—
Calm or convulsed, in breeze or gale or storm,
Icing the pole, or in the torrid clime
Dark heaving—boundless, endless, and sublime,
The image of eternity, the throne
Of the Invisible; even from out thy slime
The monsters of the deep are made; each zone
Obeys thee; thou goest forth, dread, fathomless, alone.

6.

And I have loved thee, Ocean! and my joy
Of youthful sports was on thy breast to be
Borne, like thy bubbles, onward: from a boy
I wantoned with thy breakers—they to me
Were a delight; and if the freshening sea
Made them a terror—'twas a pleasing fear,
For I was as it were a child of thee,
And trusted to thy billows far and near,
And laid my hand upon thy mane—as I do here.

To his Sister—From the Rhine.

1.

The castled crag of Drachenfels
Frowns o'er the wide and winding Rhine,
Whose breast of waters broadly swells
Between the banks which bear the vine,
And hills all rich with blossomed trees,
And fields which promise corn and wine,
And scattered cities crowning these,
Whose far white walls along them shine,
Have strewed a scene which I should see
With double joy wert *thou* with me.

2.

And peasant girls, with deep blue eyes,
And hands which offer early flowers,
Walk smiling o'er this paradise;
Above, the frequent feudal towers
Through green leaves lift their walls of gray,
And many a rock which steeply lowers,
And noble arch in proud decay,
Look o'er this vale of vintage-bowers;
But one thing want these banks of Rhine—
Thy gentle hand to clasp in mine!

3.

I send the lilies given to me;
Though long before thy hand they touch,
I know that they must withered be,
But yet reject them not as such;
For I have cherished them as dear,
Because they yet may meet thine eye,
And guide thy soul to mine even here,
When thou behold'st them drooping nigh,
And knowest them gathered by the Rhine,
And offered from my heart to thine!

4.

The river nobly foams and flows,
The charm of this enchanted ground,
And all its thousand turns disclose
Some fresher beauty varying round:
The haughtiest breast its wish might bound
Through life to dwell delighted here;

Nor could on earth a spot be found
To nature and to me so dear,
Could thy dear eyes, in following mine,
Still sweeten more these banks of Rhine!

Thrasimene[1]—*From 'Childe Harold.'*

1.

And I roam
By Thrasimene's lake, in the defiles
Fatal to Roman rashness, more at home;
For there the Carthaginian's warlike wiles
Come back before me, as his skill beguiles
The host between the mountains and the shore,
Where courage falls in her despairing files,
And torrents, swollen to rivers with their gore,
Reek through the sultry plain, with legions scattered o'er,

2.

Like to a forest felled by mountain winds;
And such the storm of battle on this day,
And such the frenzy, whose convulsion blinds
To all save carnage, that, beneath the fray,
An earthquake reeled unheededly away!
None felt stern nature rocking at his feet,
And yawning forth a grave for those who lay
Upon their bucklers for a winding-sheet;
Such is the absorbing hate when warring nations meet!

3.

The earth to them was as a rolling bark
Which bore them to eternity; they saw
The ocean round, but had no time to mark
The motions of their vessel; nature's law,
In them suspended, recked not of the awe
Which reigns when mountains tremble, and the birds
Plunge in the clouds for refuge, and withdraw
From their down-toppling nests; and bellowing herds
Stumble o'er heaving plains, and man's dread hath no words.

4.

Far other scene is Thrasimene now:
Her lake a sheet of silver, and her plain
Rent by no ravage save the gentle plough;
Her aged trees rise thick as once the slain
Lay where their roots are; but a brook hath ta'en—
A little rill of scanty stream and bed—
A name of blood from that day's sanguine rain;
And Sanguinetto tells ye where the dead
Made the earth wet, and turned the unwilling waters red.

1 The Lake of Perugia in Central Italy. The Romans were here defeated by the Carthaginian general, Hannibal, 217 B.C. Sixteen thousand Romans are said to have been either massacred or drowned in the lake, and so great was the fury on both sides as to render them unconscious of the shock of an earthquake which occurred during the battle.

Thomas Moore: 1779–1852.

The Dirge of Hinda.—From 'Lalla Rookh.'

1.

Farewell—farewell to thee, Araby's daughter!
(Thus warbled a Peri[1] beneath the dark sea)
No pearl ever lay, under Oman's green water,
More pure in its shell than thy spirit in thee.

2.

Oh! fair as the sea-flower close to thee growing,
How light was thy heart till love's witchery came,
Like the wind of the south o'er a summer lute blowing,
And hushed all its music and withered its frame!

3.

But long, upon Araby's green sunny highlands,
Shall maids and their lovers remember the doom
Of her, who lies sleeping among the Pearl Islands,
With nought but the sea-star to light up her tomb.

4.

And still, when the merry date-season is burning,
And calls to the palm-groves the young and the old,
The happiest there, from their pastime returning,
At sunset, will weep when thy story is told.

5.

The young village maid, when with flowers she dresses
Her dark flowing hair for some festival day,
Will think of thy fate till, neglecting her tresses,
She mournfully turns from the mirror away.

6.

Nor shall Iran, beloved of her hero! forget thee—
Though tyrants watch over her tears as they start,
Close, close by the side of that hero she'll set thee,
Embalmed in the innermost shrine of her heart.

7.

Farewell; be it ours to embellish thy pillow
With everything beauteous that grows in the deep;
Each flower of the rock and each gem of the billow
Shall sweeten thy bed and illumine thy sleep.

8.

Around thee shall glisten the loveliest amber
That ever the sorrowing sea-bird has wept;
With many a shell, in whose hollow-wreathed chamber,
We, Peris of Ocean, by moonlight have slept.

9.

We'll dive where the gardens of coral lie darkling,
And plant all the rosiest stems at thy head;
We'll seek where the sands of the Caspian are sparkling,
And gather their gold to strew over thy bed.

10.

Farewell—farewell—until pity's sweet fountain
Is lost in the hearts of the fair and the brave,
They'll weep for the Chieftain who died on that mountain,
They'll weep for the Maiden who sleeps in this wave.

[1] In Persian mythology, an imaginary female fairy.

James Montgomery: 1771–1854.

The Common Lot.

1.
Once, in the flight of ages past,
There lived a man:—and WHO was HE?—
Mortal! howe'er thy lot be cast,
That man resembled thee.

2.
Unknown the region of his birth,
The land in which he died unknown:
His name has perished from the earth;
This truth survives alone:

3.
That joy and grief, and hope and fear,
Alternate triumphed in his breast;
His bliss and woe—a smile, a tear!—
Oblivion hides the rest.

4.
The bounding pulse, the languid limb,
The changing spirits' rise and fall,
We know that these were felt by him,
For these are felt by all.

5.
He suffered—but his pangs are o'er;
Enjoyed—but his delights are fled;
Had friends—his friends are now no more;
And foes—his foes are dead.

6.
He loved—but whom he loved, the grave
Hath lost in its unconscious womb:
Oh, she was fair!—but nought could save
Her beauty from the tomb.

7.
He saw whatever thou hast seen;
Encountered all that troubles thee:
He was—whatever thou hast been;
He is—what thou shalt be.

8.
The rolling seasons, day and night,
Sun, moon, and stars, the earth and main,
Erewhile his portion, life, and light,
To him exist in vain. . . . .

9.
The annals of the human race,
Their ruins since the world began,
Of HIM afford no other trace
Than this—THERE LIVED A MAN!

Percy Bysshe Shelley: 1792–1822.

Ode to a Skylark.

1.
Hail to thee, blithe Spirit!
Bird thou never wert,
That from heaven, or near it,
Pourest thy full heart
In profuse strains of unpremeditated art.

2.
Higher still and higher
From the earth thou springest,
Like a cloud of fire;
The blue deep thou wingest,
And singing still dost soar, and soaring ever singest.

3.
In the golden lightning
Of the sunken sun,
O'er which clouds are brightening,
Thou dost float and run,
Like an unbodied Joy whose race is just begun.

4.
The pale purple even
Melts around thy flight;
Like a star of heaven
In the broad daylight
Thou art unseen, but yet I hear thy shrill delight:

5.
Keen as are the arrows
Of that silver sphere,
Whose intense lamp narrows
In the white dawn clear,
Until we hardly see, we feel that it is there.

6.
All the earth and air
With thy voice is loud,
As, when night is bare,
From one lonely cloud
The moon rains out her beams, and heaven is overflowed.

7.
What thou art we know not;
What is most like thee?
From rainbow clouds there flow not
Drops so bright to see
As from thy presence showers a rain of melody.

8.
Like a poet hidden
In the light of thought,
Singing hymns unbidden,
Till the world is wrought
To sympathy with hopes and fears it heeded not:

9.
Like a high-born maiden
In a palace tower,
Soothing her love-laden
Soul in secret hour
With music sweet as love, which overflows her bower:

10.
Like a glow-worm golden
In a dell of dew,
Scattering unbeholden
Its aërial hue
Among the flowers and grass, which screen it from the view:

11.
Like a rose embowered
In its own green leaves,
By warm winds deflowered,
Till the scent it gives
Makes faint with too much sweet these heavy-winged thieves.

12.
Sound of vernal showers
On the twinkling grass,
Rain-awakened flowers,
All that ever was
Joyous, and clear, and fresh, thy music doth surpass.

13.
Teach us, sprite or bird,
What sweet thoughts are thine:
I have never heard
Praise of love or wine
That panted forth a flood of rapture so divine.

14.
Chorus hymeneal,
Or triumphal chant,
Matched with thine, would be all
But an empty vaunt—
A thing wherein we feel there is some hidden want.

15.
What objects are the fountains
Of thy happy strain?

What fields, or waves, or mountains?
What shapes of sky or plain?
What love of thine own kind? what ignorance of pain?

16.

With thy clear keen joyance
Languor cannot be:
Shadow of annoyance
Never came near thee:
Thou lovest; but ne'er knew love's sad satiety.

17.

Waking or asleep,
Thou of death must deem
Things more true and deep
Than we mortals dream,
Or how could thy notes flow in such a crystal stream?

18.

We look before and after,
And pine for what is not:
Our sincerest laughter
With some pain is fraught;
Our sweetest songs are those that tell of saddest thought.

19.

Yet if we could scorn
Hate, and pride, and fear;
If we were things born
Not to shed a tear,
I know not how thy joy we ever should come near.

20.

Better than all measures
Of delightful sound,
Better than all treasures
That in books are found,
Thy skill to poet were, thou scorner of the ground!

21.

Teach me half the gladness
That thy brain must know,
Such harmonious madness
From my lips would flow,
The world should listen then, as I am listening now!

The Fugitives.

1.

The waters are flashing,
The white hail is dashing,
The lightnings are glancing,
The hoar-spray is dancing—
Away!
The whirlwind is rolling,
The thunder is tolling,
The forest is swinging,
The minster bells ringing—
Come away!
The earth is like ocean,
Wreck-strewn and in motion:
Bird, beast, man, and worm,
Have crept out of the storm—
Come away!

2.

'Our boat has one sail,
And the helmsman is pale—
A bold pilot I trow,
Who should follow us now,'
Shouted He—
And She cried: 'Ply the oar;
Put off gaily from shore!'
As she spoke, bolts of death,
Mixed with hail, specked their path
O'er the sea.
And from isle, tower, and rock,
The blue beacon-cloud broke,
Though dumb in the blast,
The red cannon flashed fast
From the lee.

3.

'And fear'st thou, and fear'st thou?
And see'st thou, and hear'st thou?
And drive we not free
O'er the terrible sea,
I and thou?'
One boat-cloak did cover
The loved and the lover—
Their blood beats one measure,
They murmur proud pleasure
Soft and low—
While around the lashed ocean,
Like mountains in motion,
Is withdrawn and uplifted,
Sunk, shattered, and shifted,
To and fro.

4.

In the court of the fortress,
Beside the pale portress,
Like a bloodhound well beaten
The bridegroom stands, eaten
By shame:
On the topmost watch-turret,
As a death-boding spirit,
Stands the gray tyrant father,
To his voice the mad weather
Seems tame;
And with curses as wild
As e'er clung to child,
He devotes to the blast
The best, loveliest, and last,
Of his name!

John Keats: 1796–1821.

To Autumn.

Who hath not seen thee oft amid thy store?
  Sometimes, whoever seeks abroad may find
Thee sitting careless on a granary floor,
  Thy hair soft-lifted by the winnowing wind;
Or on a half-reaped furrow sound asleep,
  Drowsed with the fume of poppies, while thy hook
    Spares the next swath and all its twined flowers;
And sometime like a gleaner thou dost keep
  Steady thy laden head across a brook;
  Or by a cider-press, with patient look,
    Thou watchest the last oozings, hours by hours.

Where are the songs of Spring? Ay, where are they?
  Think not of them, thou hast thy music too,
While barred clouds bloom the soft-dying day,
  And touch the stubble-plains with rosy hue;
Then in a wailful choir the small gnats mourn
  Among the river sallows, borne aloft
    Or sinking as the light wind lives or dies;
And full-grown lambs loud bleat from hilly bourn;
  Hedge-crickets sing; and now with treble soft
  The redbreast whistles from a garden croft,
    And gathering swallows twitter in the skies.

Leigh Hunt: 1784–1859.

To the Grasshopper and the Cricket.

Green little vaulter in the sunny grass,
  Catching your heart up at the feel of June,
  Sole voice that 's heard amidst the lazy noon,
When even the bees lag at the summoning brass;
And you, warm little housekeeper, who class
  With those who think the candles come too soon,
  Loving the fire, and with your tricksome tune
Nick the glad silent moments as they pass;
Oh, sweet and tiny cousins, that belong,
  One to the fields, the other to the hearth,
Both have your sunshine; both, though small, are strong
  At your clear hearts; and both seem given to earth
To ring in thoughtful ears this natural song—
  In-doors and out, summer and winter, Mirth.

William Cullen Bryant: 1794—

The Evening Wind.

1.

Spirit that breathest through my lattice, thou
  That cool'st the twilight of the sultry day,
Gratefully flows thy freshness round my brow;
  Thou hast been out upon the deep at play,
Riding all day the wild blue waves till now,
  Roughening their crests, and scattering high their spray,
And swelling the white sail. I welcome thee
To the scorched land, thou wanderer of the sea!

2.

Nor I alone—a thousand bosoms round
  Inhale thee in the fulness of delight;
And languid forms rise up, and pulses bound
  Livelier, at coming of the wind of night;
And, languishing to hear thy grateful sound,
  Lies the vast inland stretched beyond the sight.
Go forth into the gathering shade; go forth,
God's blessing breathed upon the fainting earth!

3.

Go, rock the little wood-bird in his nest,
  Curl the still waters, bright with stars, and rouse
The wide old wood from his majestic rest,
  Summoning from the innumerable boughs
The strange, deep harmonies that haunt his breast:
  Pleasant shall be thy way where meekly bows
The shutting flower, and darkling waters pass,
And where the o'ershadowing branches sweep the grass.

4.

The faint old man shall lean his silver head
  To feel thee; thou shalt kiss the child asleep,
And dry the moistened curls that overspread
  His temples, while his breathing grows more deep;
And they who stand about the sick man's bed
  Shall joy to listen to thy distant sweep,
And softly part his curtains, to allow
Thy visit, grateful to his burning brow.

5.

Go—but the circle of eternal change,
  Which is the life of nature, shall restore,
With sounds and scents from all thy mighty range,
  Thee to thy birthplace of the deep once more;
Sweet odours in the sea-air, sweet and strange,
  Shall tell the home-sick mariner of the shore;
And, listening to thy murmur, he shall deem
He hears the rustling leaf and running stream.

Lord Macaulay: 1800—1859.

Ivry, a Song of the Huguenots.

[The Huguenots was the name given to the Protestant party in France in the sixteenth century. They were cruelly persecuted by the Catholics under the Duke of Guise, and on the eve of St Bartholomew's Day (September 5), 1572, many thousands of them were massacred. Henry de Bourbon, king of Navarre, one of the Huguenots who had escaped the massacre, now headed the Protestants; the Catholics, under Guise, having meanwhile formed themselves into a *League* for the extirpation of the heretics. On the death of the French king in 1589, Henry of Navarre became sovereign of France, but the Catholics opposed his claims, and an arduous struggle ensued between the two parties. At length, in 1590, the forces of the League under the Duke of Mayenne were completely defeated at the village of Ivry, a few miles from Paris, and Henry afterwards became king.]

1.

Now glory to the Lord of Hosts, from whom all glories are!
And glory to our sovereign liege, King Henry of Navarre!
Now let there be the merry sound of music and of dance,
Through thy corn-fields green, and sunny vines, O pleasant land of France!
And thou, Rochelle,[1] our own Rochelle, proud city of the waters,
Again let rapture light the eyes of all thy mourning daughters.
As thou wert constant in our ills, be joyous in our joy,
For cold, and stiff, and still are they who wrought thy walls annoy.
Hurrah! hurrah! a single field hath turned the chance of war,
Hurrah! hurrah! for Ivry, and Henry of Navarre.

2.

Oh! how our hearts were beating, when, at the dawn of day,
We saw the army of the League drawn out in long array;
With all its priest-led citizens, and all its rebel peers,
And Appenzel's stout infantry, and Egmont's Flemish spears.
There rode the brood of false Lorraine,[2] the curses of our land;
And dark Mayenne was in the midst, a truncheon in his hand:
And, as we looked on them, we thought of Seine's empurpled flood,
And good Coligni's[3] hoary hair all dabbled with his blood;
And we cried unto the living God, who rules the fate of war,
To fight for His own holy name, and Henry of Navarre.

3.

The king is come to marshal us, all in his armour drest;
And he has bound a snow-white plume upon his gallant crest.
He looked upon his people, and a tear was in his eye;
He looked upon the traitors, and his glance was stern and high.
Right graciously he smiled on us, as rolled from wing to wing,
Down all our line, a deafening shout: 'God save our lord the king.'
'And if my standard-bearer fall, as fall full well he may—
For never saw I promise yet of such a bloody fray—
Press where ye see my white plume shine, amidst the ranks of war,
And be your oriflamme,[4] to-day, the helmet of Navarre.'

1 Rochelle was considered the Protestant capital.
2 The Guises belonged to the ducal family of Lorraine.
3 Coligni, Admiral of France, perished in the massacre of St Bartholomew.
4 The ancient royal standard of France, a little banner of red silk with many points streaming like flames, borne on a gilt staff.

4.

Hurrah! the foes are moving! Hark to the mingled din
Of fife, and steed, and trump, and drum, and roaring culverin.
The fiery Duke is *pricking* fast across St André's plain,[1] *riding*
With all the hireling chivalry of Guelders and Almayne.
Now by the lips of those ye love, fair gentlemen of France,
Charge for the golden lilies—upon them with the lance!
A thousand spurs are striking deep, a thousand spears in rest,
A thousand knights are pressing close behind the snow-white crest;
And in they burst, and on they rushed, while, like a guiding star,
Amidst the thickest carnage blazed the helmet of Navarre.

5.

Now, God be praised, the day is ours! Mayenne hath turned his rein.
D'Aumale hath cried for quarter. The Flemish Count is slain.
Their ranks are breaking like thin clouds before a Biscay gale;
The field is heaped with bleeding steeds, and flags, and cloven mail.
And then we thought on vengeance, and all along our van,
'Remember St Bartholomew,' was passed from man to man;
But out spake gentle Henry: 'No Frenchman is my foe:
Down, down with every foreigner, but let your brethren go.'
Oh! was there ever such a knight, in friendship or in war,
As our sovereign lord, King Henry, the soldier of Navarre!

6.

Right well fought all the Frenchmen who fought for France to-day;
And many a lordly banner God gave them for a prey.
But we of the religion have borne us best in fight;
And the good lord of Rosny hath ta'en the cornet white.
Our own true Maximilian the cornet white hath ta'en,
The cornet white with crosses black, the flag of false Lorraine.
Up with it high; unfurl it wide; that all the host may know
How God hath humbled the proud house which wrought His church such woe.
Then on the ground, while trumpets sound their loudest points of war,
Fling the red shreds, a foot-cloth meet for Henry of Navarre.

7.

Ho! maidens of Vienna! Ho! matrons of Lucerne!
Weep, weep, and rend your hair for those who never shall return.
Ho! Philip, send, for charity, thy Mexican pistoles,
That Antwerp monks may sing a mass for thy poor spearmen's souls!
Ho! gallant nobles of the League, look that your arms be bright;
Ho! burghers of Saint Genevieve,[2] keep watch and ward to-night.
For our God hath crushed the tyrant, our God hath raised the slave,
And mocked the counsel of the wise, and the valour of the brave.
Then glory to his holy name, from whom all glories are;
And glory to our sovereign lord, King Henry of Navarre.

[1] The battle-field.

[2] Saint Genevieve is the patron saint of Paris.

Henry Wadsworth Longfellow: 1807—

The Reaper and the Flowers.

1.

There is a Reaper, whose name is Death,
And, with his sickle keen,
He reaps the bearded grain at a breath,
And the flowers that grow between.

2.

'Shall I have nought that is fair?' saith he;
'Have nought but the bearded grain?
Though the breath of these flowers is sweet to me,
I will give them all back again.'

3.

He gazed at the flowers with tearful eyes,
He kissed their drooping leaves;
It was for the Lord of Paradise
He bound them in his sheaves.

4.

'My Lord has need of these flowerets gay,'
The Reaper said, and smiled;
'Dear tokens of the earth are they,
Where He was once a child.

5.

'They shall all bloom in fields of light,
Transplanted by my care;
And saints upon their garments white,
These sacred blossoms wear.'

6.

And the mother gave, in tears and pain,
The flowers she most did love;
She knew she should find them all again
In the fields of light above.

7.

Oh, not in cruelty, not in wrath,
The Reaper came that day;
'Twas an angel visited the green earth,
And took the Flowers away.

Midnight Mass for the Dying Year.

1.

Yes, the year is growing old,
And his eye is pale and bleared!
Death, with frosty hand and cold,
Plucks the old man by the beard,
Sorely—sorely!

2.

The leaves are falling, falling,
Solemnly and slow;
Caw! caw! the rooks are calling;
It is a sound of woe!
A sound of woe!

3.

Through woods and mountain passes,
The winds, like anthems, roll;
They are chanting solemn masses,
Singing: 'Pray for this poor soul;
Pray—pray!'

4.

And the hooded clouds, like friars,
Tell their beads in drops of rain,
And patter their doleful prayers;
But their prayers are all in vain,
All in vain!

5.

There he stands in the foul weather,
The foolish, fond Old Year,
Crowned with wild flowers and with heather,
Like weak despisèd Lear,
A king—a king!

6.

Then comes the summer-like day,
Bids the old man rejoice!
His joy! his last! Oh, the old man gray
Loveth that ever-soft voice,
Gentle and low.

7.

To the crimson woods he saith—
To the voice gentle and low
Of the soft air, like a daughter's breath—
'Pray, do not mock me so!
Do not laugh at me!'

8.

And now the sweet day is dead—
Cold in his arms it lies;
No stain from its breath is spread
Over the glassy skies,
No mist or stain!

9.

Then, too, the Old Year dieth,
And the forests utter a moan,
Like the voice of one who crieth
In the wilderness alone:
'Vex not his ghost!'

10.

Then comes, with an awful roar,
Gathering and sounding on,
The storm-wind from Labrador,
The wind Euroclydon,
The storm-wind!

11.

Howl! howl! and from the forest
Sweep the red leaves away!
Would the sins that thou abhorrest,
O Soul! could thus decay,
And be swept away!

12.

For there shall come a mightier blast,
There shall be a darker day;
And the stars, from heaven down cast,
Like red leaves be swept away;
Kyrie, eleison!
Christe, eleison!

Alfred Tennyson: 1810–

From 'Ode on the Death of the Duke of Wellington.'

Who is he that cometh, like an honoured guest,
With banner and with music, with soldier and with priest,
With a nation weeping, and breaking on my rest?
Mighty seaman, this is he
Was great by land as thou by sea.
Thine island loves thee well, thou famous man,
The greatest sailor since our world began.
Now, to the roll of muffled drums,
To thee the greatest soldier comes;
For this is he
Was great by land as thou by sea;
His martial wisdom kept us free;
O warrior-seaman, this is he,
This is England's greatest son,
Worthy of our gorgeous rites,
And worthy to be laid by thee;
He that gained a hundred fights,
And never lost an English gun;
He that in his earlier day
Against the myriads of Assaye
Clashed with his fiery few and won:
And underneath another sun
Made the soldier, led him on,
And ever great and greater grew,
Beating from the wasted vines
All their marshals' bandit swarms
Back to France with countless blows;
Till their host of eagles flew
Past the Pyrenean pines,
Followed up in valley and glen
With blare of bugle, clamour of men,
Roll of cannon and clash of arms,
And England pouring on her foes.
Such a war had such a close.
He withdrew to brief repose.
Again their ravening eagle rose
In anger, wheeled on Europe-shadowing wings,
And barking for the thrones of kings,
Till one that sought but Duty's iron crown
On that loud Sabbath shook the spoiler down;
A day of onsets of despair!
Dashed on every rocky square
Their surging charges foamed themselves away;
Last, the Prussian trumpet blew;
Through the long-tormented air
Heaven flashed a sudden jubilant ray,
And down we swept and charged and overthrew.
So great a soldier taught us there,
What long-enduring hearts could do
In that world's-earthquake, Waterloo!
Mighty seaman, tender and true,

And pure as he from taint of craven guile,
O saviour of the silver-coasted isle,
O shaker of the Baltic and the Nile,
If aught of things that here befall
Touch a spirit among things divine,
If love of country move thee there at all,
Be glad, because his bones are laid by thine!
And through the centuries let a people's voice
In full acclaim,
A people's voice,
The proof and echo of all human fame,
A people's voice, when they rejoice
At civic revel and pomp and game,
Attest their great commander's claim,
With honour, honour, honour, honour to him,
Eternal honour to his name.

The Death of the Old Year.

1.

Full knee-deep lies the winter snow,
And the winter winds are wearily sighing:
Toll ye the church-bell sad and slow,
And tread softly and speak low,
For the old year lies a-dying.
Old year, you must not die;
You came to us so readily,
You lived with us so steadily,
Old year, you shall not die.

2.

He lieth still: he doth not move:
He will not see the dawn of day.
He hath no other life above.
He gave me a friend, and a true true-love,
And the New-year will take 'em away.
Old year, you must not go;
So long as you have been with us,
Such joy as you have seen with us,
Old year, you shall not go.

3.

He frothed his bumpers to the brim;
A jollier year we shall not see.
But though his eyes are waxing dim,
And though his foes speak ill of him,
He was a friend to me.
Old year, you shall not die;
We did so laugh and cry with you,
I've half a mind to die with you,
Old year, if you must die.

4.

He was full of joke and jest,
But all his merry quips are o'er.
To see him die, across the waste
His son and heir doth ride post-haste,
But he'll be dead before.
Every one for his own.
The night is starry and cold, my friend,
And the New-year blithe and bold, my friend,
Comes up to take his own.

5.

How hard he breathes! over the snow
I heard just now the crowing cock.
The shadows flicker to and fro:
The cricket chirps: the light burns low:
'Tis nearly twelve o'clock.
Shake hands, before you die.
Old year, we'll dearly rue for you:
What is it we can do for you?
Speak out before you die.

6.

His face is growing sharp and thin.
Alack! our friend is gone.
Close up his eyes: tie up his chin:
Step from the corpse, and let him in
That standeth there alone,
And waiteth at the door.
There's a new foot on the floor, my friend,
And a new face at the door, my friend,
A new face at the door.

*** The extracts from Tennyson are inserted by permission of the publishers, Messrs A. Strahan & Co., London.

SELECTIONS FROM THE PROSE-WRITERS.

CHRONOLOGICALLY ARRANGED.

Richard Hooker: 1553–1600.

Angels.—From 'The Laws of Ecclesiastical Polity.'

But now that we may lift up our eyes (as it were) from the footstool to the throne of God, and leaving these natural, consider a little the state of heavenly and divine creatures: touching Angels, which are spirits immaterial and intellectual, the glorious inhabitants of those sacred palaces, where nothing but light and blessed immortality, no shadow of matter for tears, discontentments, griefs, and uncomfortable passions to work upon, but all joy, tranquillity, and peace, even for ever and ever doth dwell: as in number and order they are huge, mighty, and royal armies, so likewise in perfection of obedience unto that law, which the Highest, whom they adore, love, and imitate, hath imposed upon them, such observants they are thereof, that our Saviour himself being to set down the perfect *idea* of that which we are to pray and wish for on earth, did not teach to pray or wish for more than only that here it might be with us, as with them it is in heaven. God which moveth mere natural agents as an efficient only, doth otherwise move intellectual creatures, and especially His holy angels: for beholding the face of God, in admiration of so great excellency they all adore Him; and being rapt with the love of His beauty, they cleave inseparably for ever unto Him. Desire to resemble Him in goodness maketh them unwearіable and even insatiable in their longing to do by all means all manner good unto all the creatures of God, but especially unto the children of men: in the countenance of whose nature, looking downward, they behold themselves beneath themselves; even as upward, in God, beneath whom themselves are, they see that character which is nowhere but in themselves and us resembled. Thus far even the Painims[1]

[1] 'Pagans, the heathen.'

have approached; thus far they have seen into the doings of the angels of God; Orpheus confessing, that *the fiery throne of God is attended on by those most industrious angels, careful how all things are performed amongst men;*[1] and the Mirror[2] of human wisdom plainly teaching, that God moveth angels, even as that thing doth stir man's heart, which is thereunto presented amiable. Angelical actions may therefore be reduced unto these three general kinds: first, most delectable love arising from the visible apprehension of the purity, glory, and beauty of God, invisible saving only unto spirits that are pure: secondly, adoration grounded upon the evidence of the greatness of God, on whom they see how all things depend; thirdly, imitation, bred by the presence of his exemplary goodness, who ceaseth not before them daily to fill heaven and earth with the rich treasures of most free and undeserved grace.

Francis Bacon: 1561–1626.

Of Studies.—From his 'Essays.'

Studies serve for delight, for ornament, and for ability. Their chief use for delight is in privateness and retiring; for ornament, is in discourse; and for ability, is in the judgment and disposition of business; for expert men can execute, and perhaps judge of particulars, one by one; but the general counsels, and the plots and marshalling of affairs, come best from those that are learned. To spend too much time in studies, is sloth; to use them too much for ornament, is affectation; to make judgment wholly by their rules, is the humour of a scholar; they perfect nature, and are perfected by experience—for natural abilities are like natural plants, that need pruning by study; and studies themselves do give forth directions too much at large, except they be bounded in by experience. Crafty men contemn studies, simple men admire them, and wise men use them; for they teach not their own use; but that is a wisdom without them, and above them, won by observation. Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse, but to weigh and consider. Some books are to be tasted, others to be swallowed, and some few to be chewed and digested: that is, some books are to be read only in parts; others to be read, but not curiously; and some few to be read wholly, and with diligence and attention. Some books also may be read by deputy, and extracts made of them by others; but that would be only in the less important arguments, and the meaner sort of

[1] A quotation from a series of poems under the name of Orpheus, but which are believed to be, for the most part, forgeries written at Alexandria in the first centuries after Christ.

[2] 'Aristotle,' a Greek philosopher (384–322 B.C.), the reference being to a passage of his metaphysics, made use of by Thomas Aquinas, an Italian theologian (1224–1274).

books; else distilled books are, like common distilled waters, flashy things. Reading maketh a full man; conference a ready man; and writing an exact man; and, therefore, if a man write little, he had need have a great memory; if he confer little, he had need have a present wit; and if he read little, he had need have much cunning, to seem to know that he doth not. Histories make men wise; poets, witty; the mathematics, subtle; natural philosophy, deep; moral, grave; logic and rhetoric, able to contend: 'Studies influence the manners;' nay, there is no stand or impediment in the wit, but may be wrought out by fit studies; like as diseases of the body may have appropriate exercises—bowling is good for the stone and reins, shooting for the lungs and breast, gentle walking for the stomach, riding for the head, and the like; so, if a man's wit be wandering, let him study the mathematics, for in demonstrations, if his wit be called away never so little, he must begin again; if his wit be not apt to distinguish or find differences, let him study the schoolmen, for they are hair-splitters; if he be not apt to beat over matters, and to call upon one thing to prove and illustrate another, let him study the lawyers' cases—so every defect of the mind may have a special receipt.

Jeremy Taylor: 1613–1667.

Prayer.—From 'Golden Grove Sermons.'

Prayer is an action of likeness to the Holy Ghost, the spirit of gentleness and dove-like simplicity; an imitation of the holy Jesus, whose spirit is meek, up to the greatness of the biggest example, and a conformity to God, whose anger is always just, and marches slowly, and is without transportation, and often hindered, and never hasty, and is full of mercy; prayer is the peace of our spirit, the stillness of our thoughts, the evenness of recollection, the seat of meditation, the rest of our cares, and the calm of our tempest; prayer is the issue of a quiet mind, of untroubled thoughts; it is the daughter of charity, and the sister of meekness; and he that prays to God with an angry, that is, with a troubled and discomposed spirit, is like him that retires into a battle to meditate, and sets up his closet in the out-quarters of an army, and chooses a frontier garrison to be wise in. Anger is a perfect alienation of the mind from prayer, and therefore is contrary to that attention which presents our prayers in a right line to God. For so have I seen a lark rising from his bed of grass, and soaring upwards, singing as he rises, and hopes to get to heaven, and climb above the clouds; but the poor bird was beaten back with the loud sighings of an eastern wind, and his motion made irregular and inconstant, descending more at every breath of the tempest than it could recover by the libration and frequent weighing of his wings; till the little creature

was forced to sit down and pant, and stay till the storm was over, and then it made a prosperous flight, and did rise and sing as if it had learned music and motion from an angel, as he passed sometimes through the air, about his ministries here below. So is the prayer of a good man; when his affairs have required business, and his business was matter of discipline, and his discipline was to pass upon a sinning person, or had a design of charity, his duty met with infirmities of a man, and anger was its instrument, and the instrument became stronger than the prime agent, and raised a tempest, and overruled the man; and then his prayer was broken, and his thoughts were troubled, and his words went up towards a cloud, and his thoughts pulled them back again, and made them without intention; and the good man sighs for his infirmity, and must be content to lose the prayer, and he must recover it when his anger is removed, and his spirit is becalmed, made even as the brow of Jesus, and smooth like the heart of God; and then it ascends to heaven upon the wings of the holy dove, and dwells with God till it returns, like the useful bee, loaden with a blessing and the dew of heaven.

John Milton: 1608—1674.

From 'Areopagitica;'[1] a speech for the liberty of unlicensed printing, to the Parliament of England.'

And that we are to hope better of all these supposed sects and schisms, and that we shall not need that solicitude, honest perhaps, though overtimorous, of them that vex in his behalf, but shall laugh in the end, at those malicious applauders of our differences, I have these reasons to persuade me.

First, when a city shall be as it were besieged and blocked about, her navigable river infested, inroads and incursions round, defiance and battle oft rumoured to be marching up even to her walls, and suburb trenches, that then the people, or the greater part, more than at other times, wholly taken up with the study of highest and most important matters to be reformed, should be disputing, reasoning, reading, inventing, discoursing, even to a rarity and admiration, things not before discoursed or written of, argues first a singular good-will, contentedness and confidence in your prudent foresight, and safe government, Lords and Commons; and from thence derives itself to a gallant bravery and well grounded contempt of their enemies, as if there were no small number of as great spirits among us, as his was, who when Rome was nigh besieged by Hannibal, being in

[1] 'Pertaining to the Areopagus,' or Hill of Mars at Athens, on which a council used to assemble.

the city, bought that piece of ground at no cheap rate, whereon Hannibal himself encamped his own regiment. Next, it is a lively and cheerful presage of our happy success and victory. For as in a body, when the blood is fresh, the spirits pure and vigorous, not only to vital but to rational faculties, and those in the acutest and the pertest operations of wit and subtlety, it argues in what good plight and constitution the body is, so when the cheerfulness of the people is so sprightly up, as that it has not only wherewith to guard well its own freedom and safety, but to spare, and to bestow upon the solidest and sublimest points of controversy, and new invention, it betoken us not degenerated, nor drooping to a fatal decay, but casting off the old and wrinkled skin of corruption to outlive these pangs and wax young again, entering the glorious ways of Truth and prosperous virtue destined to become great and honourable in these latter ages. Methinks I see in my mind a noble and puissant nation rousing herself like a strong man after sleep, and shaking her invincible locks: Methinks I see her as an eagle mewing her mighty youth, and kindling her undazzled eyes at the full mid-day beam; purging and unscaling her long abused sight at the fountain itself of heavenly radiance, while the whole noise of timorous and flocking birds, with those also that love the twilight, flutter about, amazed at what she means, and in their envious gabble would prognosticate a year of sects and schisms.

What should ye do then? Should ye suppress all this flowery crop of knowledge and new light sprung up, and yet springing daily in this city? should ye set an *oligarchy* of twenty ingrossers over it, to bring a famine upon our minds again, when we shall know nothing but what is measured to us by their bushel? Believe it, Lords and Commons, they who counsel ye to such a suppressing, do as good as bid ye suppress yourselves; and I will soon shew how. If it be desired to know the immediate cause of all this free writing and free speaking, there cannot be assigned a truer than your own mild, and free, and humane government; it is the liberty, Lords and Commons, which your own valorous and happy counsels have purchased us, liberty which is the nurse of all great wits; this is that which hath rarified and enlightened our spirits like the influence of heaven; this is that which hath enfranchised, enlarged, and lifted up our apprehensions degrees above themselves. Ye cannot make us now less capable, less knowing, less eagerly pursuing of the truth, unless ye first make yourselves, that made us so, less the lovers, less the founders of our true liberty. We can grow ignorant again, brutish, formal, and slavish, as ye found us; but you then must first become that which ye cannot be, oppressive, arbitrary, and tyrannous, as they were from whom ye have freed us. That our hearts are now more capacious, our thoughts more erected to the search and expectation of greatest and exactest things, is the issue of your own virtue propagated in us; ye cannot suppress that unless

ye reinforce an abrogated and merciless law, that fathers may despatch at will their own children. And who shall then stick closest to ye, and excite others? not he who takes up arms for coat and conduct, and his four nobles of Danegelt.[1] Although I dispraise not the defence of just immunities, yet love my peace better, if that were all. Give me the liberty to know, to utter, and to argue freely according to conscience, above all liberties.

Abraham Cowley: 1618–1667.

His Youth.—From his Essay 'Of Myself.'

As far as my memory can return back into my past life, before I knew or was capable of guessing what the world, or glories, or business of it were, the natural affections of my soul gave a secret bent of aversion from them, as some plants are said to turn away from others, by an antipathy imperceptible to themselves, and inscrutable to man's understanding. Even when I was a very young boy at school, instead of running about on holidays, and playing with my fellows, I was wont to steal from them, and walk into the fields, either alone with a book, or with some one companion, if I could find any of the same temper. I was then, too, so much an enemy to constraint, that my masters could never prevail on me, by any persuasions or encouragements, to learn, without book, the common rules of grammar, in which they dispensed with me alone, because they found I made a shift to do the usual exercise out of my own reading and observation. That I was then of the same mind as I am now—which, I confess, I wonder at myself—may appear at the latter end of an ode which I made when I was but thirteen years old, and which was then printed, with many other verses. The beginning of it is boyish; but of this part which I here set down, if a very little were corrected, I should hardly now be much ashamed.

'This only grant me, that my means may lie
Too low for envy, for cóntempt too high.
Some honour I would have,
Not from great deeds, but good alone;
Th' unknown are better than ill-known.
Rumour can ope the grave:
Acquaintance I would have; but when 't depends
Not on the number, but the choice of friends.

Books should, not business, entertain the light,
And sleep, as undisturbed as death, the night.
My house a cottage, more

[1] Dane-gold, a tax levied by the Anglo-Saxons to meet the outlay requisite for the defence of the country against the Danes.

Than palace, and should fitting be
For all my use, no luxury.
My garden painted o'er
With Nature's hand, not Art's; and pleasures yield,
Horace[1] might envy in his Sabine field.

Thus would I double my life's fading space,
For he that runs it well, twice runs his race.
And in this true delight,
These unbought sports, that happy state,
I would not fear nor wish my fate,
But boldly say each night,
To-morrow let my sun his beams display,
Or in clouds hide them; I have lived to-day.'

You may see by it I was even then acquainted with the poets, for the conclusion is taken out of Horace; and perhaps it was the immature and immoderate love of them which stamped first, or rather engraved, the characters in me. They were like letters cut in the bark of a young tree, which, with the tree, still grow proportionably. But how this love came to be produced in me so early, is a hard question: I believe I can tell the particular little chance that filled my head first with such chimes of verse, as have never since left ringing there: for I remember when I began to read, and take some pleasure in it, there was wont to lie in my mother's parlour—I know not by what accident, for she herself never in her life read any book but of devotion—but there was wont to lie Spenser's works; this I happened to fall upon, and was infinitely delighted with the stories of the knights, and giants, and monsters, and brave houses, which I found everywhere there—though my understanding had little to do with all this—and by degrees, with the tinkling of the rhyme, and dance of the numbers; so that I think I had read him all over before I was twelve years old. With these affections of mind, and my heart wholly set upon letters, I went to the university; but was soon torn from thence by that public violent storm, which would suffer nothing to stand where it did, but rooted up every plant, even from the princely cedars, to me, the hyssop.

Edward Hyde, Earl of Clarendon: 1608–1674.

Adventures of Charles II. after the Battle of Worcester.—From 'History of the Rebellion.'

[Charles II., after the Battle of Worcester, concealed himself in a wood.]

When the darkness of the night was over, after the king had cast himself into that wood, he discerned another man, who had gotten upon

[1] Horace, a Roman poet, lived on a farm at Tivoli, in the Sabine country, north-east of Rome.

an oak in the same wood, near the place where the king had rested himself, and had slept soundly. The man upon the tree had first seen the king, and knew him, and came down to him, and was known to the king, being a gentleman of the neighbour county of Staffordshire, who had served his late majesty during the war, and had now been one of the few who resorted to the king after his coming to Worcester. His name was Careless, who had had a command of foot, about the degree of a captain, under the Lord Loughborough. He persuaded the king, since it could not be safe for him to go out of the wood, and that, as soon as it should be fully light, the wood itself would probably be visited by those of the country, who would be searching to find those whom they might make prisoners, that he would get up into that tree where he had been, where the boughs were so thick with leaves that a man would not be discovered there without a narrower inquiry than people usually make in places which they do not suspect. The king thought it good counsel; and, with the other's help, climbed into the tree, and then helped his companion to ascend after him, where they sat all that day, and securely saw many who came purposely into the wood to look after them, and heard all their discourse, how they would use the king himself if they could take him. . . . .

The day being spent in the tree, it was not in the king's power to forget that he had lived two days with eating very little, and two nights with as little sleep; so that, when the night came, he was willing to make some provision for both; and he resolved, with the advice and assistance of his companion, to leave his blessed tree; and, when the night was dark, they walked through the wood into those enclosures which were furthest from any highway, and making a shift to get over hedges and ditches, after walking at least eight or nine miles, which were the more grievous to the king by the weight of his boots—for he could not put them off when he cut off his hair, for want of shoes—before morning they came to a poor cottage, the owner whereof being a Roman Catholic, was known to Careless. He was called up, and as soon as he knew one of them, he easily concluded in what condition they both were, and presently carried them into a little barn full of hay, which was a better lodging than he had for himself. But when they were there, and had conferred with their host of the news and temper of the country, it was agreed that the danger would be the greater if they stayed together; and, therefore, that Careless should presently be gone, and should, within two days, send an honest man to the king, to guide him to some other place of security; and in the meantime, his majesty should stay upon the hay-mow. The poor man had nothing for him to eat, but promised him good butter-milk; and so he was once more left alone, his companion, how weary soever, departing from him before day, the poor man of the house knowing no

more than that he was a friend of the captain's, and one of those who had escaped from Worcester. The king slept very well in his lodging, till the time that his host brought him a piece of bread and a great pot of butter-milk, which he thought the best food he ever had eaten. . . . .

After he had rested upon this hay-mow and fed upon this diet two days and two nights, in the evening before the third night, another fellow, a little above the condition of his host, came to the house, sent from Careless, to conduct the king to another house, more out of any road near which any part of the army was like to march. It was above twelve miles that he was to go, and was to use the same caution he had done the first night, not to go in any common road, which his guide knew well how to avoid. Here he new dressed himself, changing clothes with his landlord: he had a great mind to have kept his own shirt; but he considered, that men are not sooner discovered by any mark in disguises than by having fine linen in ill clothes; and so he parted with his shirt too, and took the same his poor host had then on. Though he had foreseen that he must leave his boots, and his landlord had taken the best care he could to provide an old pair of shoes, yet they were not easy to him when he first put them on, and in a short time after, grew very grievous to him. In this equipage he set out from his first lodging in the beginning of the night, under the conduct of this guide, who guided him the nearest way, crossing over hedges and ditches, that they might be in least danger of meeting passengers. This was so grievous a march, and he was so tired, that he was even ready to despair, and to prefer being taken and suffered to rest, before purchasing his safety at that price. His shoes had, after a few miles, hurt him so much that he had thrown them away, and walked the rest of the way in his ill stockings, which were quickly worn out; and his feet, with the thorns in getting over hedges, and with the stones in other places, were so hurt and wounded, that he many times cast himself upon the ground, with a desperate and obstinate resolution to rest there till the morning, that he might shift with less torment, what hazard soever he run. But his stout guide still prevailed with him to make a new attempt, sometimes promising that the way should be better, and sometimes assuring him that he had but little farther to go; and in this distress and perplexity, before the morning they arrived at the house designed; which, though it was better than that which he had left, his lodging was still in the barn, upon straw instead of hay, a place being made as easy in it as the expectation of a guest could dispose it. Here he had such meat and porridge as such people use to have, with which, but especially with the butter and the cheese, he thought himself well feasted; and took the best care he could to be supplied with other, little better, shoes and stockings; and after his feet were enough recovered that he could go, he was conducted from thence to another poor house, within

such a distance as put him not to much trouble; for having not yet in his thought which way or by what means to make his escape, all that was designed was only, by shifting from one house to another, to avoid discovery.

Isaac Barrow: 1630–1677.

Charity.—From his 'Sermons.'

Charity is the imitation and copy of that immense love which is the fountain of all being and all good; which made all things; which preserveth the world; which sustaineth every creature: nothing advanceth us so near to a resemblance of Him who is essential love and goodness; who freely and purely, without any regard to His own advantage or capacity of finding any beneficial return, doth bear and express the highest good-will, with a liberal hand pouring down showers of bounty and mercy on all His creatures; who daily putteth up numberless indignities and injuries, upholding and maintaining those who provoke him. Charity rendereth us as angels, or peers to those glorious and blessed creatures, who, without receiving or expecting any requital from us, do heartily desire and delight in our good; are ready to promote it; do willingly serve and labour for it. Nothing is more amiable, more admirable, more venerable, even in the common eye and opinion of men; it hath in it a beauty and a majesty apt to ravish every heart; even a spark of it, in generosity of dealing, breedeth admiration; a glimpse of it in formal courtesy of behaviour procureth much esteem, being deemed to accomplish and adorn a man. How lovely, therefore, and truly gallant is an entire, sincere, constant, and uniform practice thereof, issuing from pure good-will and affection!

Love, indeed, or goodness (for true love is nothing else but goodness exerting itself in direction toward objects capable of its influence), is the only amiable and only honourable thing; power and wit may be admired by some, or have some fond idolaters; but being severed from goodness, or abstracted from their subserviency to it, they cannot obtain real love, they deserve not any esteem; for the worst, the most unhappy, the most odious and contemptible of beings, do partake of them in high measure: the Prince of Darkness hath more power, and reigneth with absolute sovereignty over more subjects by many than the Great Turk; one devil may have more wit than all the politic Ahithophels and all the profane Hectors in the world; yet, with all his power and all his wit, he is most wretched, most detestable, and most despicable: and such in proportion is every one who partaketh in his accursed dispositions of malice and uncharitableness.

For, on the other side, uncharitableness is a very mean and base thing; it contracteth a man's soul into a narrow compass, or straiteneth it, as it were, into one point—drawing all his thoughts, his desires, his affections, into himself as to their centre; so that his reason, his will, his activity, have but one pitiful object to exercise themselves about: to scrape together a little pelf, to catch a vapour of fame, to prog[1] for a frivolous semblance of power or dignity; to soothe the humour or pamper the sensuality of one poor worm, is the ignoble subject of his busy care and endeavour.

John Dryden: 1631–1700.

Shakspeare.

To begin, then, with Shakspeare. He was the man who, of all modern and perhaps ancient poets, had the largest and most comprehensive soul. All the images of nature were still present to him, and he drew them not laboriously, but luckily. When he describes anything, you more than see it—you feel it too. Those who accuse him to have wanted learning, give him the greater commendation. He was naturally learned; he needed not the spectacles of books to read nature; he looked inwards, and found her there. I cannot say he is everywhere alike; were he so, I should do him injury to compare him with the greatest of mankind. He is many times flat, insipid; his comic wit degenerating into clenches, his serious swelling into bombast. But he is always great when some great occasion is presented to him; no man can say he ever had a fit subject for his wit, and did not then raise himself as high above the rest of poets

'As the cypress towers above surrounding shrubs.'—*Virgil.*

The consideration of this made Mr Hales of Eton say, that there was no subject of which any poet ever writ, but he would produce it much better done in Shakspeare; and however others are now generally preferred before him, yet the age wherein he lived, which had contemporaries with him Fletcher and Jonson, never equalled them to him in their esteem. And in the last king's court, when Ben's reputation was at highest, Sir John Suckling, and with him the greater part of the courtiers, set our Shakspeare far above him.

Ben Jonson.

As for Jonson, to whose character I am now arrived, if we look upon him while he was himself—for his last plays were but his dotages—I think him the most learned and judicious writer which any theatre ever had. He was a most severe judge of himself, as well as others. One

[1] To beg, or seek by low arts.

cannot say he wanted wit, but rather that he was frugal of it. In his works, you find little to retrench or alter. Wit, and language, and humour also in some measure, we had before him; but something of art was wanting to the drama, till he came. He managed his strength to more advantage than any who preceded him. You seldom find him making love in any of his scenes, or endeavouring to move the passions; his genius was too sullen and saturnine to do it gracefully, especially when he knew he came after those who had performed both to such a height. Humour was his proper sphere; and in that he delighted most to represent mechanic people. He was deeply conversant in the ancients, both Greek and Latin, and he borrowed boldly from them; there is scarce a poet or historian among the Roman authors of those times whom he has not translated in *Sejanus* and *Catiline*. But he has done his robberies so openly, that one may see he fears not to be taxed by any law. He invades authors like a monarch; and what would be theft in other poets, is only victory in him. With the spoils of these writers he so represented Rome to us, in its rites, ceremonies, and customs, that if one of their poets had written either of his tragedies, we had seen less of it than in him. If there was any fault in his language, 'twas that he weaved it too closely and laboriously, in his comedies especially: perhaps, too, he did a little too much Romanise our tongue, leaving the words which he translated almost as much Latin as he found them; wherein, though he learnedly followed their language, he did not enough comply with the idiom of ours. If I would compare him with Shakspeare, I must acknowledge him the more correct poet, but Shakspeare the greater wit. Shakspeare was the Homer, or father of our dramatic poets: Jonson was the Virgil, the pattern of elaborate writing; I admire him, but I love Shakspeare.

John Locke: 1632–1704.

Of Practice and Habits.—From 'The Conduct of the Human Understanding.'

We are born with faculties and powers capable almost of anything, such at least as would carry us further than can be easily imagined; but it is only the exercise of those powers which gives us ability and skill in anything, and leads us towards perfection.

A middle-aged ploughman will scarce ever be brought to the carriage and language of a gentleman, though his body be as well proportioned, and his joints as supple, and his natural parts not any way inferior. The legs of a dancing-master, and the fingers of a musician, fall, as it were, naturally without thought or pains into regular and admirable motions.

Bid them change their parts, and they will in vain endeavour to produce like motions in the members not used to them, and it will require length of time and long practice to attain but some degrees of a like ability. What incredible and astonishing actions do we find rope-dancers and tumblers bring their bodies to! not but that sundry in almost all manual arts are as wonderful; but I name those which the world takes notice of for such, because, on that very account, they give money to see them. All these admired motions, beyond the reach, and almost the conception of unpractised spectators, are nothing but the mere effects of use and industry in men whose bodies have nothing peculiar in them from those of the amazed lookers-on.

As it is in the body, so it is in the mind; practice makes it what it is; and most even of those excellences which are looked on as natural endowments, will be found, when examined into more narrowly, to be the product of exercise, and to be raised to that pitch only by repeated actions. Some men are remarked for pleasantness in raillery, others for apologues and apposite diverting stories. This is apt to be taken for the effect of pure nature, and that the rather, because it is not got by rules, and those who excel in either of them, never purposely set themselves to the study of it as an art to be learned. But yet it is true, that at first some lucky hit which took with somebody, and gained him commendation, encouraged him to try again, inclined his thoughts and endeavours that way, till at last he insensibly got a facility in it without perceiving how; and that is attributed wholly to nature, which was much more the effect of use and practice. I do not deny that natural disposition may often give the first rise to it; but that never carries a man far without use and exercise, and it is practice alone that brings the powers of the mind as well as those of the body to their perfection. Many a good poetic vein is buried under a trade, and never produces anything for want of improvement. We see the ways of discourse and reasoning are very different, even concerning the same matter, at court and in the university. And he that will go but from Westminster Hall to the Exchange, will find a different genius and turn in their ways of talking; and one cannot think that all whose lot fell in the city were born with different parts from those who were bred at the university or inns of court.

To what purpose all this, but to shew that the difference, so observable in men's understandings and parts, does not arise so much from the natural faculties, as acquired habits? He would be laughed at that should go about to make a fine dancer out of a country hedger, at past fifty. And he will not have much better success who shall endeavour at that age to make a man reason well, or speak handsomely, who has never been used to it, though you should lay before him a collection of all the best precepts of logic or oratory. Nobody is made anything by hearing of rules, or

laying them up in his memory; practice must settle the habit of doing without reflecting on the rule; and you may as well hope to make a good painter or musician, extempore, by a lecture and instruction in the arts of music and painting, as a coherent thinker, or strict reasoner, by a set of rules, shewing him wherein right reasoning consists.

This being so, that defects and weakness in men's understandings, as well as other faculties, come from want of a right use of their own minds, I am apt to think the fault is generally mislaid upon nature, and there is often a complaint of want of parts, when the fault lies in want of a due improvement of them. We see men frequently dexterous and sharp enough in making a bargain, who, if you reason with them about matters of religion, appear perfectly stupid.

Daniel Defoe: 1661–1731.

Incident during the Plague in London.—From 'History of the Plague.'

It is said that it was a blind piper; but, as John told me, the fellow was not blind, but an ignorant, weak, poor man, and usually went his rounds about ten o'clock at night, and went piping along from door to door, and the people usually took him in at public-houses where they knew him, and would give him drink and victuals, and sometimes farthings; and he in return would pipe and sing, and talk simply, which diverted the people, and thus he lived. It was but a very bad time for this diversion, while things were as I have told, yet the poor fellow went about as usual, but was almost starved; and when anybody asked how he did, he would answer, the dead-cart had not taken him yet, but that they had promised to call for him next week.

It happened one night that this poor fellow, whether somebody had given him too much drink or no (John Hayward said he had not drink in his house, but that they had given him a little more victuals than ordinary at a public-house in Coleman Street), and the poor fellow having not usually had a bellyful, or, perhaps, not a good while, was laid all along upon the top of a bulk or stall, and fast asleep at a door, in the street near London-wall, towards Cripplegate, and that, upon the same bulk or stall, the people of some house, in the alley of which the house was a corner, hearing a bell, which they always rung before the cart came, had laid a body really dead of the plague just by him, thinking too that this poor fellow had been a dead body as the other was, and laid there by some of the neighbours.

Accordingly, when John Hayward with his bell and the cart came along, finding two dead bodies lie upon the stall, they took them up with

the instrument they used, and threw them into the cart; and all this while the piper slept soundly.

From hence they passed along, and took in other dead bodies, till, as honest John Hayward told me, they almost buried him alive in the cart, yet all this while he slept soundly; at length the cart came to the place where the bodies were to be thrown into the ground, which, as I do remember, was at Mountmill; and as the cart usually stopped some time before they were ready to shoot out the melancholy load they had in it, as soon as the cart stopped, the fellow awaked, and struggled a little to get his head out from among the dead bodies, when, raising himself up in the cart, he called out: 'Hey, where am I?'

This frighted the fellow that attended about the work, but, after some pause, John Hayward, recovering himself, said: 'Lord bless us! there's somebody in the cart not quite dead.'

So another called to him, and said: 'Who are you?'

The fellow answered: 'I am the poor piper—where am I?'

'Where are you!' says Hayward; 'why, you are in the dead-cart, and we are going to bury you.'

'But I an't dead though, am I?' says the piper; which made them laugh a little, though, as John said, they were heartily frightened at first: so they helped the poor fellow down, and he went about his business.

I know the story goes, he set up his pipes in the cart, and frighted the bearers and others, so that they ran away; but John Hayward did not tell the story so, nor say anything of his piping at all; but that he was a poor piper, and that he was carried away as above, I am fully satisfied of the truth of.

Sir Richard Steele: 1675–1729.

Quack Advertisements.—From 'The Spectator.'

It gives me much despair in the design of reforming the world by my speculations, when I find there always arise, from one generation to another, successive cheats and bubbles, as naturally as beasts of prey and those which are to be their food. There is hardly a man in the world, one would think, so ignorant as not to know that the ordinary quack-doctors, who publish their abilities in little brown billets, distributed to all who pass by, are to a man impostors and murderers; yet such is the credulity of the vulgar, and the impudence of these professors, that the affair still goes on, and new promises of what was never done before are made every day. What aggravates the jest is, that even this promise has been made as long as the memory of man can trace it, and yet nothing performed, and yet still prevails. As I was passing along to-day, a paper

given into my hand by a fellow without a nose, tells us as follows what good news is come to town:

'In Russel Court, over against the Cannon Ball, at the Surgeons' Arms, in Drury Lane, is lately come from his travels a surgeon, who hath practised surgery and physic, both by sea and land, these twenty-four years. He, by the blessing, cures the yellow jaundice, green-sickness, scurvy, dropsy, surfeits, long sea-voyages, campaigns, &c., as some people that has been lame these thirty years can testify; in short, he cureth all diseases incident to men, women, or children.'

If a man could be so indolent as to look upon this havoc of the human species which is made by vice and ignorance, it would be a good ridiculous work to comment upon the declaration of this accomplished traveller. There is something unaccountably taking among the vulgar in those who come from a great way off. Ignorant people of quality, as many there are of such, dote excessively this way; many instances of which every man will suggest to himself, without my enumeration of them. The ignorants of lower order, who cannot, like the upper ones, be profuse of their money to those recommended by coming from a distance, are no less complaisant than the others; for they venture their lives for the same admiration.

'The doctor is lately come from his travels, and has practised both by sea and land, and therefore cures the green-sickness, long sea-voyages, and 'campaigns.' Both by sea and land! I will not answer for the distempers called 'sea-voyages and campaigns,' but I daresay that of green-sickness might be as well taken care of if the doctor stayed ashore. But the art of managing mankind is only to make them stare a little to keep up their astonishment; to let nothing be familiar to them, but ever to have something in their sleeve, in which they must think you are deeper than they are. There is an ingenious fellow, a barber, of my acquaintance, who, besides his broken fiddle and a dried sea-monster, has a twine-cord, strained with two nails at each end, over his window, and the words 'rainy, dry, wet,' and so forth, written to denote the weather, according to the rising or falling of the cord. We very great scholars are not apt to wonder at this; but I observed a very honest fellow, a chance customer, who sat in the chair before me to be shaved, fix his eye upon this miraculous performance during the operation upon his chin and face. When those and his head also were cleared of all encumbrances and excrescences, he looked at the fish, then at the fiddle, still grubbing in his pockets, and casting his eye again at the twine, and the words writ on each side; then altered his mind as to farthings, and gave my friend a silver sixpence. The business, as I said, is to keep up the amazement; and if my friend had only the skeleton and kit, he must have been contented with a less payment. But the doctor we were talking of adds to his long voyages the testimony of some people 'that has been thirty years lame.' When I

received my paper, a sagacious fellow took one at the same time, and read until he came to the thirty years' confinement of his friends, and went off very well convinced of the doctor's sufficiency. You have many of these prodigious persons, who have had some extraordinary accident at their birth, or a great disaster in some part of their lives. Anything, however foreign from the business the people want of you, will convince them of your ability in that you profess. There is a doctor in Mouse Alley, near Wapping, who sets up for curing cataracts upon the credit of having, as his bill sets forth, lost an eye in the emperor's service. His patients come in upon this, and he shews his muster-roll, which confirms that he was in his imperial majesty's troops; and he puts out their eyes with great success. Who would believe that a man should be a doctor for the cure of bursten children, by declaring that his father and grandfather were born bursten? But Charles Ingoltson, next door to the Harp in Barbican, has made a pretty penny by that asseveration. The generality go upon their first conception, and think no further; all the rest is granted. They take it that there is something uncommon in you, and give you credit for the rest. You may be sure it is upon that I go, when, sometimes, let it be to the purpose or not, I keep a Latin sentence in my front; and I was not a little pleased when I observed one of my readers say, casting his eye on my twentieth paper: 'More Latin still? What a prodigious scholar is this man!' But as I have here taken much liberty with this learned doctor, I must make up all I have said by repeating what he seems to be in earnest in, and honestly promise to those who will not receive him as a great man, to wit: 'That from eight to twelve, and from two till six, he attends for the good of the public to bleed for threepence.'

Joseph Addison: 1672–1719.

Meditations in Westminster Abbey.—From 'The Spectator.'

When I am in a serious humour, I very often walk by myself in Westminster Abbey; where the gloominess of the place, and the use to which it is applied, with the solemnity of the building, and the condition of the people who lie in it, are apt to fill the mind with a kind of melancholy, or rather thoughtfulness, that is not disagreeable. I yesterday passed a whole afternoon in the churchyard, the cloisters, and the church, amusing myself with the tombstones and inscriptions that I met with in those several regions of the dead. Most of them recorded nothing else of the buried person, but that he was born upon one day, and died upon another; the whole history of his life being comprehended in those two circumstances that are common to all mankind. I could not but look

upon these registers of existence, whether of brass or marble, as a kind of satire upon the departed persons; who had left no other memorial of them, but that they were born, and that they died. They put me in mind of several persons mentioned in battles of heroic poems, who have sounding names given them, for no other reason but that they may be killed, and are celebrated for nothing but being knocked on the head.

The life of these men is finely described in Holy Writ by 'the path of an arrow,' which is immediately closed up and lost.

Upon my going into the church, I entertained myself with the digging of a grave; and saw in every shovelful of it that was thrown up, the fragment of a bone or skull intermixed with a kind of fresh mouldering earth, that some time or other had a place in the composition of a human body. Upon this I began to consider with myself, what innumerable multitudes of people lay confused together under the pavement of that ancient cathedral; how men and women, friends and enemies, priests and soldiers, monks and prebendaries, were crumbled amongst one another, and blended together in the same common mass; how beauty, strength, and youth, with old age, weakness, and deformity, lay undistinguished in the same promiscuous heap of matter.

After having thus surveyed this great magazine of mortality as it were in the lump, I examined it more particularly by the accounts which I found on several of the monuments which are raised in every quarter of that ancient fabric. Some of them were covered with such extravagant epitaphs, that if it were possible for the dead person to be acquainted with them, he would blush at the praises which his friends have bestowed upon him. There are others so excessively modest, that they deliver the character of the person departed in Greek or Hebrew, and by that means are not understood once in a twelvemonth. In the poetical quarter, I found there were poets who had no monuments, and monuments which had no poets. I observed, indeed, that the present war had filled the church with many of these uninhabited monuments, which had been erected to the memory of persons whose bodies were perhaps buried in the plains of Blenheim, or in the bosom of the ocean.

I could not but be very much delighted with several modern epitaphs, which are written with great elegance of expression and justness of thought, and therefore do honour to the living as well as the dead. As a foreigner is very apt to conceive an idea of the ignorance or politeness of a nation from the turn of their public monuments and inscriptions, they should be submitted to the perusal of men of learning and genius before they are put in execution. Sir Cloudesly Shovel's monument has very often given me great offence. Instead of the brave rough English admiral, which was the distinguishing character of that plain gallant man, he is represented on his tomb by the figure of a beau, dressed in a long periwig,

and reposing himself upon velvet cushions under a canopy of state. The inscription is answerable to the monument; for, instead of celebrating the many remarkable actions he had performed in the service of his country, it acquaints us only with the manner of his death, in which it was impossible for him to reap any honour. The Dutch, whom we are apt to despise for want of genius, shew an infinitely greater taste of antiquity and politeness in their buildings and works of this nature, than what we meet with in those of our own country. The monuments of their admirals, which have been erected at the public expense, represent them like themselves, and are adorned with rostral crowns and naval ornaments, with beautiful festoons of sea-weed, shells, and coral.

But to return to our subject. I have left the repository of our English kings for the contemplation of another day, when I shall find my mind disposed for so serious an amusement. I know that entertainments of this nature are apt to raise dark and dismal thoughts in timorous minds and gloomy imaginations; but for my own part, though I am always serious, I do not know what it is to be melancholy; and can therefore take a view of Nature in her deep and solemn scenes, with the same pleasure as in her most gay and delightful ones. By this means I can improve myself with those objects which others consider with terror. When I look upon the tombs of the great, every emotion of envy dies in me; when I read the epitaphs of the beautiful, every inordinate desire goes out; when I meet with the grief of parents upon a tombstone, my heart melts with compassion; when I see the tomb of the parents themselves, I consider the vanity of grieving for those whom we must quickly follow. When I see kings lying by those who deposed them, when I consider rival wits placed side by side, or the holy men that divided the world with their contests and disputes, I reflect with sorrow and astonishment on the little competitions, factions, and debates of mankind. When I read the several dates of the tombs, of some that died yesterday, and some six hundred years ago, I consider that great day when we shall all of us be contemporaries, and make our appearance together.

The Works of Creation.

I was yesterday about sunset walking in the open fields, until the night insensibly fell upon me. I at first amused myself with all the richness and variety of colours which appeared in the western parts of heaven. In proportion as they faded away and went out, several stars and planets appeared one after another, until the whole firmament was in a glow. The blueness of the ether was exceedingly heightened and enlivened by the season of the year, and by the rays of all those luminaries that passed through it. The galaxy appeared in its most beautiful white. To complete

the scene, the full moon rose at length in that clouded majesty which Milton takes notice of, and opened to the eye a new picture of nature, which was more finely shaded, and disposed among softer lights, than that which the sun had before discovered to us.

As I was surveying the moon walking in her brightness, and taking her progress among the constellations, a thought rose in me which I believe very often perplexes and disturbs men of serious and contemplative natures. David himself fell into it in that reflection: 'When I consider the heavens, the work of thy fingers, the moon and the stars, which thou hast ordained, what is man, that thou art mindful of him? and the son of man, that thou regardest him?' In the same manner, when I considered that infinite host of stars, or, to speak more philosophically, of suns, which were then shining upon me, with those innumerable sets of planets or worlds which were moving round their respective suns—when I still enlarged the idea, and supposed another heaven of suns and worlds rising still above this which we discovered, and these still enlightened by a superior firmament of luminaries, which are planted at so great a distance, that they may appear to the inhabitants of the former as the stars do to us—in short, while I pursued this thought, I could not but reflect on that little insignificant figure which I myself bore amidst the immensity of God's works.

Were the sun which enlightens this part of the creation, with all the host of planetary worlds that move about him, utterly extinguished and annihilated, they would not be missed more than a grain of sand upon the sea-shore. The space they possess is so exceedingly little in comparison of the whole, that it would scarce make a blank in the creation. The chasm would be imperceptible to an eye that could take in the whole compass of nature, and pass from one end of the creation to the other; as it is possible there may be such a sense in ourselves hereafter, or in creatures which are at present more exalted than ourselves. We see many stars by the help of glasses which we do not discover with our naked eyes; and the finer our telescopes are, the more still are our discoveries. Huygenius carries this thought so far, that he does not think it impossible there may be stars whose light has not yet travelled down to us since their first creation. There is no question but the universe has certain bounds set to it; but when we consider that it is the work of infinite power prompted by infinite goodness, with an infinite space to exert itself in, how can our imagination set any bounds to it?

Jonathan Swift: 1667–1745.

The Spider and the Bee.

[From *The Battle of the Books*, written to support his patron, Sir William Temple, in his dispute as to the relative merits of ancient and modern learning; the Bee representing the ancients, the Spider the moderns.]

Upon the highest corner of a large window in the library, there dwelt a certain spider, swollen up to the first magnitude by the destruction of infinite numbers of flies, whose spoils lay scattered before the gates of his palace, like human bones before the cave of some giant. The avenues to his castle were guarded with turnpikes and palisadoes, all after the modern way of fortification. After you had passed several courts, you came to the centre, wherein you might behold the constable himself in his own lodgings, which had windows fronting to each avenue, and ports to sally out on all occasions of prey or defence. In this mansion he had for some time dwelt in peace and plenty, without danger to his person by swallows from above, or to his palace by brooms from below; when it was the pleasure of fortune to conduct thither a wandering bee, to whose curiosity a broken pane in the glass had discovered itself, and in he went, where, expatiating a while, he at last happened to alight upon one of the outward walls of the spider's citadel, which, yielding to the unequal weight, sunk down to the very foundation. Thrice he endeavoured to force his passage, and thrice the centre shook. The spider within, feeling the terrible convulsion, supposed at first that nature was approaching to her final dissolution; or else that Beelzebub, with all his legions, was come to revenge the death of many thousands of his subjects whom his enemy had slain and devoured. However, he at length valiantly resolved to issue forth and meet his fate. Meanwhile, the bee had acquitted himself of his toils, and, posted securely at some distance, was employed in cleansing his wings, and disengaging them from the ragged remnants of the cobweb.

By this time the spider was adventured out, when, beholding the chasms, the ruins, and dilapidations of his fortress, he was very near at his wits' end; he stormed and swore like a madman, and swelled till he was ready to burst. At length, casting his eye upon the bee, and wisely gathering causes from events, for they knew each other by sight: 'Rogue, rogue,' cried the spider, 'you should have more respect to a person whom all the world allows to be so much your betters.' 'By my troth,' says the bee, 'the comparison will amount to a very good jest; and you will do me the favour to let me know the reasons that all the world is pleased to use in so hopeful a dispute.' At this the spider, having swelled himself into the size and posture of a disputant,

began his argument in the true spirit of controversy, with resolution to be heartily scurrilous and angry, to urge on his own reasons, without the least regard to the answers or objections of his opposite, and fully predetermined in his mind against all conviction. 'Not to disparage myself,' said he, 'by the comparison with such a rascal, what art thou but a vagabond without house or home, without stock or inheritance, born to no possession of your own, but a pair of wings and a drone-pipe? Your livelihood is a universal plunder upon nature; a freebooter over fields and gardens; and, for the sake of stealing, will rob a nettle as easily as a violet. Whereas I am a domestic animal, furnished with a stock within myself. This large castle (to shew my improvements in the mathematics) is all built with my own hands, and the materials extracted altogether out of my own person.'

'I am glad,' answered the bee, 'to hear you grant, at least, that I am come honestly by my wings and my voice; for then, it seems, I am obliged to Heaven alone for my flights and my music, and providence would never have bestowed on me two such gifts, without designing them for the noblest ends. I visit, indeed, all the flowers and blossoms of the field and garden; but whatever I collect thence enriches myself, without the least injury to their beauty, their smell, or their taste. Now, for you and your skill in architecture and mathematics, I have little to say: in that building of yours there might, for aught I know, have been labour and method enough; but by woeful experience for us both, it is too plain the materials are naught; and I hope you will henceforth take warning, and consider duration and matter, as well as method and art. You boast indeed of being obliged to no other creature, but of drawing and spinning out all from yourself—that is to say, if we may judge of the liquor in the vessel by what issues out, you possess a good plentiful store of dirt and poison in your breast; and, though I would by no means lessen or disparage your genuine stock of either, yet I doubt you are somewhat obliged for an increase of both to a little foreign assistance. Your inherent portion of dirt does not fail of acquisitions by sweepings exhaled from below; and one insect furnishes you with a share of poison to destroy another. So that, in short, the question comes all to this: Whether is the nobler being of the two, that which by a lazy contemplation of four inches round, by an overweening pride, feeding and engendering on itself, turns all into venom, producing nothing at all but fly-bane and a cobweb; or that which by a universal range, with long search, much study, true judgment, and distinction of things, brings home honey and wax?' This dispute was managed with such eagerness, clamour, and warmth, that the two parties of books, in arms below, stood silent a while, waiting in suspense what would be the issue, which was not long undetermined; for the bee, grown impatient at so

much loss of time, fled straight away to a bed of roses, without looking for a reply, and left the spider, like an orator, collected in himself, and just prepared to burst out.

It happened on this emergency that Æsop broke silence first. He had been of late most barbarously treated by a strange effect of the regent's humanity,[1] who had torn off his title-page, sorely defaced one half of his leaves, and chained him fast among a shelf of moderns: where, soon discovering how high the quarrel was likely to proceed, he tried all his arts, and turned himself into a thousand forms. At length, in the borrowed shape of an ass, the regent mistook him for a modern; by which means he had time and opportunity to escape to the ancients, just when the spider and the bee were entering into their contest; to which he gave his attention with a world of pleasure, and when it was ended, swore in the loudest key, that in all his life he had never known two cases so parallel and adapt to each other, as that in the window and this upon the shelves. The disputants, said he, have admirably managed the dispute between them, have taken in the full strength of all that is to be said on both sides, and exhausted the substance of every argument *pro* and *con*. It is but to adjust the reasonings of both to the present quarrel, then to compare the labours and fruits of each, as the bee has learnedly deduced them, and we shall find the conclusion fall plain and close upon the moderns and us. For, pray, gentlemen, was ever anything so modern as the spider in his air, his turns, and his paradoxes? he argues in behalf of you his brethren and himself with many boastings of his native stock and great genius; that he spins wholly from himself, and scorns to own any obligation or assistance from without. Then he displays to you his great skill in architecture and improvement in the mathematics. To all this the bee, as an advocate retained by us the ancients, thinks fit to answer, that if one may judge of the great genius or inventions of the moderns by what they have produced, you will hardly have countenance to bear you out in boasting of either. Erect your schemes with as much method and skill as you please; yet, if the materials be nothing but dirt spun out of your own brains, the edifice will conclude at last in a cobweb; the duration of which, like that of other spiders' webs, may be imputed to their being forgotten, or neglected, or hid in a corner. For anything else of genuine that the moderns may pretend to, I cannot recollect; unless it be a large vein of wrangling and satire, much of a nature and substance with the spider's poison; which, however they pretend to spit wholly out of themselves, is improved by the same arts, by feeding upon the insects and vermin of the age. As for us, the ancients, we are content, with the bee, to pretend to nothing

[1] Richard Bentley, who had written a work to shew that the greater part of Æsop's Fables was of comparatively modern date.

of our own beyond our wings and our voice—that is to say, our flights and our language. For the rest, whatever we have got has been by infinite labour and search, and ranging through every corner of nature; the difference is, that instead of dirt and poison, we have rather chosen to fill our hives with honey and wax, thus furnishing mankind with the two noblest of things, which are sweetness and light.

Henry Fielding: 1707–1754.

Adventure with a Highwayman.—From 'Tom Jones.'

They were got about two miles beyond Barnet, and it was now the dusk of the evening, when a genteel-looking man, but upon a very shabby horse, rode up to Jones, and asked him whether he was going to London, to which Jones answered in the affirmative. The gentleman replied: 'I should be obliged to you, sir, if you will accept of my company, for it is very late, and I am a stranger to the road.' Jones readily complied with the request; and on they travelled together, holding that sort of discourse which is usual on such occasions.

Of this, indeed, robbery was the principal topic, upon which subject the stranger expressed great apprehensions; but Jones declared he had very little to lose, and consequently as little to fear. Here Partridge could not forbear putting in his word: 'Your honour,' said he, 'may think it a little, but I am sure, if I had a hundred-pound bank-note in my pocket, as you have, I should be very sorry to lose it; but, for my part, I never was less afraid in my life, for we are four of us, and if we all stand by one another, the best man in England can't rob us. Suppose he should have a pistol, he can't kill but one of us, and a man can die but once—that's my comfort, a man can die but once.'

Besides the reliance on superior numbers, a kind of valour which hath raised a certain nation among the moderns to a high pitch of glory, there was another reason for the extraordinary courage which Partridge now discovered; for he had at present as much of that quality as was in the power of liquor to bestow.

Our company were now arrived within a mile of Highgate, when the stranger turned short upon Jones, and, pulling out a pistol, demanded that little bank-note which Partridge had mentioned.

Jones was at first somewhat shocked at this unexpected demand; however, he presently recollected himself, and told the highwayman all the money he had in his pocket was at his service; and so saying, he pulled out upwards of three guineas and offered to deliver it, but the other answered with an oath, 'That would not do.' Jones answered coolly, he was very sorry for it, and returned the money into his pocket.

The highwayman then threatened, if he did not deliver the bank-note that moment, he must shoot him, holding his pistol at the same time very near to his breast. Jones instantly caught hold of the fellow's hand, which trembled so that he could scarce hold the pistol in it, and turned the muzzle from him. A struggle then ensued, in which the former wrested the pistol from the hand of his antagonist, and both came from their horses to the ground together, the highwayman upon his back, and the victorious Jones upon him.

The poor fellow now began to implore mercy of the conqueror; for, to say the truth, he was in strength by no means a match for Jones. 'Indeed, sir,' says he, 'I could have had no intention to shoot you, for you will find the pistol was not loaded. This is the first robbery I ever attempted, and I have been driven by distress to this.'

At this instant, at about a hundred and fifty yards' distance, lay another person on the ground, roaring for mercy in a much louder voice than the highwayman. This was no other than Partridge himself, who, endeavouring to make his escape from the engagement, had been thrown from his horse, and lay flat on his face, not daring to look up, and expecting every minute to be shot. In this posture he lay, till the guide, who was no otherwise concerned than for his horses, having secured the stumbling beast, came up to him, and told him his master had got the better of the highwayman.

Partridge leaped up at the news, and ran back to the place where Jones stood with his sword drawn in his hand to guard the poor fellow, which Partridge no sooner saw than he cried out: 'Kill the villain, sir; run him through the body; kill him this instant!'

Luckily, however, for the poor wretch, he had fallen into more merciful hands; for Jones having examined the pistol, and found it to be really unloaded, began to believe all the man had told him before Partridge came up—namely, that he was a novice in the trade, and that he had been driven to it by the distress he mentioned—the greatest indeed imaginable, that of five hungry children, and a wife in the utmost want and misery. The truth of all which the highwayman most vehemently asserted, and offered to convince Mr Jones of it, if he would take the trouble to go to his house, which was not above two miles off, saying 'that he desired no favour, but upon condition of proving all he had alleged.'

Jones at first pretended that he would take the fellow at his word, and go with him, declaring that his fate should depend entirely on the truth of his story. Upon this the poor fellow immediately expressed so much alacrity, that Jones was perfectly satisfied with his veracity, and began now to entertain sentiments of compassion for him. He returned the fellow his empty pistol, advised him to think of honester means of relieving his distress, and gave him a couple of guineas for the immediate support

of his wife and his family; adding, 'he wished he had more for his sake, for the hundred pound that had been mentioned was not his own.' . . . .

The highwayman was full of expressions of thankfulness and gratitude. He actually dropped tears, or pretended so to do. He vowed he would immediately return home, and would never afterwards commit such a transgression.

Samuel Johnson: 1709—1784.

Letter to the Earl of Chesterfield.

My Lord—I have been lately informed, by the proprietor of the *World*, that two papers, in which my Dictionary is recommended to the public, were written by your lordship. To be so distinguished, is an honour, which, being very little accustomed to favours from the great, I know not well how to receive, or in what terms to acknowledge.

When, upon some slight encouragement, I first visited your lordship, I was overpowered, like the rest of mankind, by the enchantment of your address, and could not forbear to wish that I might boast myself *Le vainqueur du vainqueur de la terre;*[1] that I might obtain that regard for which I saw the world contending; but I found my attendance so little encouraged, that neither pride nor modesty would suffer me to continue it. When I had once addressed your lordship in public, I had exhausted all the art of pleasing which a retired and uncourtly scholar can possess. I had done all that I could; and no man is well pleased to have his all neglected, be it ever so little.

Seven years, my lord, have now passed since I waited in your outward rooms, or was repulsed from your door; during which time I have been pushing on my work through difficulties, of which it is useless to complain, and have brought it, at last, to the verge of publication, without one act of assistance, one word of encouragement, or one smile of favour. Such treatment I did not expect, for I never had a patron before.

The shepherd in Virgil grew at last acquainted with Love, and found him a native of the rocks.

Is not a patron, my lord, one who looks with unconcern on a man struggling for life in the water, and when he has reached the ground, encumbers him with help? The notice which you have been pleased to take of my labours, had it been early, had been kind; but it has been delayed till I am indifferent, and cannot enjoy it; till I am solitary, and cannot impart it; till I am known, and do not want it. I hope it is no very cynical asperity not to confess obligations where no benefit has been

[1] 'The conqueror of the world's conqueror.'

received, or to be unwilling that the public should consider me as owing that to a patron, which Providence has enabled me to do for myself.

Having carried on my work thus far with so little obligation to any favourer of learning, I shall not be disappointed though I should conclude it, if less be possible, with less; for I have been long wakened from that dream of hope, in which I once boasted myself with so much exultation, my lord, your lordship's most humble, most obedient servant,

SAMUEL JOHNSON.

From the Preface to his Dictionary.

In hope of giving longevity to that which its own nature forbids to be immortal, I have devoted this book, the labour of years, to the honour of my country, that we may no longer yield the palm of philology, without a contest, to the nations of the continent. The chief glory of every people arises from its authors: whether I shall add anything by my own writings to the reputation of English literature, must be left to time; much of my life has been lost under the pressures of disease; much has been trifled away; and much has always been spent in provision for the day that was passing over me; but I shall not think my employment useless or ignoble, if, by my assistance, foreign nations and distant ages gain access to the propagators of knowledge, and understand the teachers of truth; if my labours afford light to the repositories of science, and add celebrity to Bacon, to Hooker, to Milton, and to Boyle.

When I am animated by this wish, I look with pleasure on my book, however defective, and deliver it to the world with the spirit of a man that has endeavoured well. That it will immediately become popular, I have not promised to myself; a few wild blunders and risible absurdities, from which no work of such multiplicity was ever free, may for a time furnish folly with laughter, and harden ignorance into contempt; but useful diligence will at last prevail, and there can never be wanting some who distinguish desert, who will consider that no dictionary of a living tongue ever can be perfect, since, while it is hastening to publication, some words are budding and some falling away; that a whole life cannot be spent upon syntax and etymology, and that even a whole life would not be sufficient; that he whose design includes whatever language can express, must often speak of what he does not understand; that a writer will sometimes be hurried by eagerness to the end, and sometimes faint with weariness under a task which Scaliger[1] compares to the labours of the anvil and the mine; that what is obvious is not always known, and what is known is not always present; that sudden fits of inadvertency will surprise vigilance, slight avocations will seduce attention, and casual

[1] A Frenchman (1540—1609), one of the most illustrious scholars of his day. He latterly filled the chair of Literature in the University of Leyden.

eclipses of the mind will darken learning; and that the writer shall often in vain trace his memory at the moment of need for that which yesterday he knew with intuitive readiness, and which will come uncalled into his thoughts to-morrow.

In this work, when it shall be found that much is omitted, let it not be forgotten that much likewise is performed; and though no book was ever spared out of tenderness to the author, and the world is little solicitous to know whence proceeded the faults of that which it condemns, yet it may gratify curiosity to inform it, that the English Dictionary was written with little assistance of the learned, and without any patronage of the great; not in the soft obscurities of retirement, or under the shelter of academic bowers, but amid inconvenience and distraction, in sickness and in sorrow. It may repress the triumph of malignant criticism to observe, that if our language is not here fully displayed, I have only failed in an attempt which no human powers have hitherto completed. If the lexicons of ancient tongues, now immutably fixed, and comprised in a few volumes, be yet, after the toil of successive ages, inadequate and delusive; if the aggregated knowledge and co-operating diligence of the Italian academicians did not secure them from the censure of Beni;[1] if the embodied critics of France, when fifty years had been spent upon their work, were obliged to change its economy, and give their second edition another form, I may surely be contented without the praise of perfection, which, if I could obtain in this gloom of solitude, what would it avail me? I have protracted my work till most of those whom I wished to please have sunk into the grave, and success and miscarriage are empty sounds. I therefore dismiss it with frigid tranquillity, having little to fear or hope from censure or from praise.

David Hume: 1711—1776.

The Middle Station of Life.

We may remark of the middle station of life, that it is more favourable to the acquiring of wisdom and ability, as well as of virtue, and that a man so situate has a better chance for attaining a knowledge both of men and things than those of a more elevated station. He enters with more familiarity into human life, and everything appears in its natural colours before him: he has more leisure to form observations; and has, besides, the motive of ambition to push him on in his attainments, being certain that he can never rise to any distinction or eminence in the world without his own industry. And here I cannot forbear communicating a remark, which may appear somewhat extraordinary—namely, that it is wisely

[1] A famous Italian critic (1552—1625).

ordained by Providence that the middle station should be the most favourable to the improving our natural abilities, since there is really more capacity requisite to perform the duties of that station, than is requisite to act in the higher spheres of life. There are more natural parts and a stronger genius requisite to make a good lawyer or physician, than to make a great monarch. For, let us take any race or succession of kings, where birth alone gives a title to the crown; the English kings, for instance, who have not been esteemed the most shining in history. From the Conquest to the succession of his present majesty, we may reckon twenty-eight sovereigns, omitting those who died minors. Of these, eight are esteemed princes of great capacity—namely, the Conqueror, Harry II., Edward I., Edward III., Harry V. and VII., Elizabeth, and the late King William. Now, I believe every one will allow, that, in the common run of mankind, there are not eight out of twenty-eight who are fitted by nature to make a figure either on the bench or at the bar. Since Charles VII., ten monarchs have reigned in France, omitting Francis II. Five of those have been esteemed princes of capacity—namely, Louis XI., XII., and XIV., Francis I., and Harry IV. In short, the governing of mankind well requires a great deal of virtue, justice, and humanity, but not a surprising capacity. A certain pope, whose name I have forgot, used to say: 'Let us divert ourselves, my friends; the world governs itself.' There are indeed some critical times, such as those in which Harry IV. lived, that call for the utmost vigour; and a less courage and capacity than what appeared in that great monarch must have sunk under the weight. But such circumstances are rare; and even then fortune does at least one half of the business.

Since the common professions, such as law or physic, require equal, if not superior capacity to what are exerted in the higher spheres of life, it is evident that the soul must be made of still a finer mould, to shine in philosophy or poetry, or in any of the higher parts of learning. Courage and resolution are chiefly requisite in a commander, justice and humanity in a statesman, but genius and capacity in a scholar. Great generals and great politicians are found in all ages and countries of the world, and frequently start up at once, even amongst the greatest barbarians. Sweden was sunk in ignorance when it produced Gustavus Ericson and Gustavus Adolphus; Muscovy, when the Czar appeared; and perhaps Carthage when it gave birth to Hannibal. But England must pass through a long gradation of its Spensers, Jonsons, Wallers, Drydens, before it arrive at an Addison or a Pope. A happy talent for the liberal arts and sciences is a kind of prodigy among men. Nature must afford the richest genius that comes from her hands; education and example must cultivate it from the earliest infancy; and industry must concur to carry it to any degree of perfection. No man needs be surprised to see Kouli-Khan among the

Persians; but Homer, in so early an age among the Greeks, is certainly matter of the highest wonder.

A man cannot shew a genius for war who is not so fortunate as to be trusted with command; and it seldom happens, in any state or kingdom, that several at once are placed in that situation. How many Marlboroughs were there in the confederate army, who never rose so much as to the command of a regiment? But I am persuaded there has been but one Milton in England within these hundred years, because every one may exert the talents of poetry who is possessed of them; and no one could exert them under greater disadvantages than that divine poet. If no man were allowed to write verses but the person who was beforehand named to be laureate, could we expect a poet in ten thousand years?

Were we to distinguish the ranks of men by their genius and capacity, more than by their virtue and usefulness to the public, great philosophers would certainly challenge the first rank, and must be placed at the top of mankind. So rare is this character, that perhaps there has not as yet been above two in the world who can lay a just claim to it. At least Galileo and Newton seem to me so far to excel all the rest, that I cannot admit any other into the same class with them.

Great poets may challenge the second place; and this species of genius, though rare, is yet much more frequent than the former. Of the Greek poets that remain, Homer alone seems to merit this character; of the Romans, Virgil, Horace, and Lucretius; of the English, Milton and Pope; Corneille, Racine, Boileau, and Voltaire of the French; and Tasso and Ariosto of the Italians.

Great orators and historians are perhaps more rare than great poets; but as the opportunities for exerting the talents requisite for eloquence, or acquiring the knowledge requisite for writing history, depend in some measure upon fortune, we cannot pronounce these productions of genius to be more extraordinary than the former.

Character of Queen Elizabeth.—From his 'History of England.'

There are few great personages in history who have been more exposed to the calumny of enemies, and the adulation of friends, than Queen Elizabeth; and yet there scarcely is any whose reputation has been more certainly determined by the unanimous consent of posterity. The unusual length of her administration, and the strong features of her character, were able to overcome all prejudices; and obliging her detractors to abate much of their invectives, and her admirers somewhat of their panegyrics, have at last, in spite of political factions, and, what is more, of religious animosities, produced a uniform judgment with regard to her conduct. Her vigour, her constancy, her magnanimity, her penetration, vigilance, address, are allowed to merit the highest

praises, and appear not to have been surpassed by any person that ever filled a throne. A conduct less rigorous, less imperious, more sincere, more indulgent to her people, would have been requisite to form a perfect character. By the force of her mind, she controlled all her more active and stronger qualities, and prevented them from running into excess. Her heroism was exempt from temerity, her frugality from avarice, her friendship from partiality, her active temper from turbulency and a vain ambition. She guarded not herself with equal care or equal success from lesser infirmities—the rivalship of beauty, the desire of admiration, the jealousy of love, and the sallies of anger.

Her singular talents for government were founded equally on her temper and on her capacity. Endowed with a great command over herself, she soon obtained an uncontrolled ascendant over her people; and while she merited all their esteem by her real virtues, she also engaged their affection by her pretended ones. Few sovereigns of England succeeded to the throne in more difficult circumstances; and none ever conducted the government with such uniform success and felicity. Though unacquainted with the practice of toleration, the true secret for managing religious factions, she preserved her people, by her superior prudence, from those confusions in which theological controversy had involved all the neighbouring nations. And though her enemies were the most powerful princes of Europe—the most active, the most enterprising, the least scrupulous—she was able, by her vigour, to make deep impressions on their state: her own greatness, meanwhile, remained untouched and unimpaired.

The wise ministers and brave warriors who flourished under her reign share the praise of her success; but instead of lessening the applause due to her, they make great addition to it. They owed, all of them, their advancement to her choice; they were supported by her constancy; and, with all their ability, they were never able to acquire any undue ascendant over her. In her family, in her court, in her kingdom, she remained equally mistress. The force of the tender passions was great over her, but the force of her mind was still superior; and the combat, which her victory visibly cost her, serves only to display the firmness of her resolution, and the loftiness of her ambitious sentiments.

The fame of this princess, though it has surmounted the prejudices both of faction and bigotry, yet lies still exposed to another prejudice, which is more durable because more natural, and which, according to the different views in which we survey her, is capable either of exalting beyond measure, or diminishing the lustre of her character. This prejudice is founded on the consideration of her sex. When we contemplate her as a woman, we are apt to be struck with the highest admiration of her great qualities and extensive capacity; but we are also apt to require some

more softness of disposition, some greater lenity of temper, some of those amiable weaknesses by which her sex is distinguished. But the true method of estimating her merit is to lay aside all these considerations, and consider her merely as a rational being placed in authority, and intrusted with the government of mankind. We may find it difficult to reconcile our fancy to her as a wife or a mistress; but her qualities as a sovereign, though with some considerable exceptions, are the object of undisputed applause and approbation.

Laurence Sterne: 1713—1768.

The Starling—Captivity.—From the 'Sentimental Journey.'

And as for the Bastille, the terror is in the word. Make the most of it you can, said I to myself, the Bastille is but another word for a tower, and a tower is but another word for a house you can't get out of. Mercy on the gouty! for they are in it twice a year; but with nine livres a day, and pen, and ink, and paper, and patience, albeit a man can't get out, he may do very well within, at least for a month or six weeks; at the end of which, if he is a harmless fellow, his innocence appears, and he comes out a better and wiser man than he went in.

I had some occasion—I forget what—to step into the court-yard as I settled this account; and remember I walked down-stairs in no small triumph with the conceit of my reasoning. Beshrew the sombre pencil! said I vauntingly, for I envy not its powers which paint the evils of life with so hard and deadly a colouring. The mind sits terrified at the objects she has magnified herself and blackened: reduce them to their proper size and hue, she overlooks them. 'Tis true,' said I, correcting the proposition, 'the Bastille is not an evil to be despised; but strip it of its towers, fill up the fosse, unbarricade the doors, call it simply a confinement, and suppose 'tis some tyrant of a distemper and not of a man which holds you in it, the evil vanishes, and you bear the other half without complaint.' I was interrupted in the heyday of this soliloquy with a voice which I took to be of a child, which complained 'it could not get out.' I looked up and down the passage, and seeing neither man, woman, nor child, I went out without further attention. In my return back through the passage, I heard the same words repeated twice over; and looking up, I saw it was a starling hung in a little cage: 'I can't get out, I can't get out,' said the starling. I stood looking at the bird; and to every person who came through the passage, it ran fluttering to the side towards which they approached it, with the same lamentation of its captivity: 'I can't get out,' said the starling. 'God help thee!' said I; 'but I'll let thee out, cost what it will.' So I turned about the

cage to get the door. It was twisted and double twisted so fast with wire, there was no getting it open without pulling the cage to pieces. I took both hands to it. The bird flew to the place where I was attempting his deliverance, and thrusting his head through the trellis, pressed his breast against it as if impatient. 'I fear, poor creature,' said I, 'I cannot set thee at liberty.' 'No,' said the starling, 'I can't get out; I can't get out,' said the starling. I vow I never had my affections more tenderly awakened; nor do I remember an incident in my life where the dissipated spirits, to which my reason had been a bubble, were so suddenly called home. Mechanical as the notes were, yet so true in tune to nature were they chanted, that in one moment they overthrew all my systematic reasons upon the Bastille; and I heavily walked upstairs, unsaying every word I had said in going down them.

'Disguise thyself as thou wilt, still, Slavery,' said I, 'still thou art a bitter draught; and though thousands in all ages have been made to drink of thee, thou art no less bitter on that account. 'Tis thou, thrice sweet and gracious goddess,' addressing myself to Liberty, 'whom all in public or in private worship, whose taste is grateful, and ever will be so, till nature herself shall change; no tint of words can spot thy snowy mantle, or chemic power turn thy sceptre into iron; with thee to smile upon him as he eats his crust, the swain is happier than his monarch, from whose court thou art exiled. Gracious Heaven!' cried I, kneeling down upon the last step but one in my ascent, 'grant me but health, thou great bestower of it, and give me but this fair goddess as my companion, and shower down thy mitres, if it seem good unto thy divine providence, upon those heads which are aching for them.'

The bird in his cage pursued me into my room. I sat down close to my table, and leaning my head upon my hand, I began to figure to myself the miseries of confinement. I was in a right frame for it, and so I gave full scope to my imagination. I was going to begin with the millions of my fellow-creatures born to no inheritance but slavery; but finding, however affecting the picture was, that I could not bring it near me, and that the multitude of sad groups in it did but distract me, I took a single captive, and having first shut him up in his dungeon, I then looked through the twilight of his grated door to take his picture. I beheld his body half wasted away with long expectation and confinement, and felt what kind of sickness of the heart it was which arises from hope deferred. Upon looking nearer, I saw him pale and feverish; in thirty years the western breeze had not once fanned his blood; he had seen no sun, no moon, in all that time, nor had the voice of friend or kinsman breathed through his lattice; his children—but here my heart began to bleed, and I was forced to go on with another part of the portrait. He was sitting upon the ground upon a little straw, in the furthest corner of

his dungeon, which was alternately his chair and bed: a little calendar of small sticks lay at the head, notched all over with the dismal days and nights he had passed there; he had one of these little sticks in his hand, and with a rusty nail he was etching another day of misery to add to the heap. As I darkened the little light he had, he lifted up a hopeless eye towards the door, then cast it down, shook his head, and went on with his work of affliction. I heard his chains upon his legs, as he turned his body to lay his little stick upon the bundle. He gave a deep sigh: I saw the iron enter into his soul. I burst into tears: I could not sustain the picture of confinement which my fancy had drawn.

William Robertson: 1721–1793.

Character of Mary Queen of Scots.—From his 'History of Scotland.'

To all the charms of beauty and the utmost elegance of external form, Mary added those accomplishments which render their impression irresistible. Polite, affable, insinuating, sprightly, and capable of speaking and of writing with equal ease and dignity. Sudden, however, and violent in all her attachments, because her heart was warm and unsuspicious. Impatient of contradiction, because she had been accustomed from her infancy to be treated as a queen. No stranger, on some occasions, to dissimulation, which, in that perfidious court where she received her education, was reckoned among the necessary arts of government. Not insensible of flattery, or unconscious of that pleasure with which almost every woman beholds the influence of her own beauty. Formed with the qualities which we love, not with the talents that we admire, she was an agreeable woman rather than an illustrious queen.

The vivacity of her spirit, not sufficiently tempered with sound judgment, and the warmth of her heart, which was not at all times under the restraint of discretion, betrayed her both into errors and into crimes. To say that she was always unfortunate will not account for that long and almost uninterrupted succession of calamities which befell her; we must likewise add that she was often imprudent. Her passion for Darnley was rash, youthful, and excessive. And though the sudden transition to the opposite extreme was the natural effect of her ill-requited love, and of his ingratitude, insolence, and brutality, yet neither these nor Bothwell's artful address and important services can justify her attachment to that nobleman. Even the manners of the age, licentious as they were, are no apology for this unhappy passion; nor can they induce us to look on that tragical and infamous scene which followed upon it with less abhorrence. Humanity will draw a veil over this part of her character which it cannot approve, and may, perhaps, prompt some to impute her actions to her

situation more than to her dispositions, and to lament the unhappiness of the former rather than accuse the perverseness of the latter. Mary's sufferings exceed, both in degree and in duration, those tragical distresses which fancy has feigned to excite sorrow and commiseration; and while we survey them, we are apt altogether to forget her frailties; we think of her faults with less indignation, and approve of our tears as if they were shed for a person who had attained much nearer to pure virtue.

With regard to the queen's person, a circumstance not to be omitted in writing the history of a female reign, all contemporary authors agree in ascribing to Mary the utmost beauty of countenance and elegance of shape of which the human form is capable. Her hair was black, though, according to the fashion of that age, she frequently wore borrowed locks, and of different colours. Her eyes were a dark gray, her complexion was exquisitely fine, and her hands and arms remarkably delicate, both as to shape and colour. Her stature was of a height that rose to the majestic. She danced, she walked, and rode with equal grace. Her taste for music was just, and she both sung and played upon the lute with uncommon skill. 'No man,' says Brantome,[1] 'ever beheld her person without admiration and love, or will read her history without sorrow.'

Tobias George Smollett: 1721–1771.

Commodore Trunnion's Ride to Church.—From 'Peregrine Pickle.'

The fame of this extraordinary conjunction spread all over the county; and on the day appointed for their spousals, the church was surrounded by an inconceivable multitude. The commodore, to give a specimen of his gallantry, by the advice of his friend Hatchway, resolved to appear on horseback on the grand occasion, at the head of all his male attendants, whom he had rigged with the white shirts and black caps formerly belonging to his barge's crew; and he bought a couple of hunters for the accommodation of himself and his lieutenant. With this equipage, then, he set out from the garrison for the church, after having despatched a messenger to apprise the bride that he and his company were mounted. She got immediately into the coach, accompanied by her brother and his wife, and drove directly to the place of assignation, where several pews were demolished, and divers persons almost pressed to death, by the eagerness of the crowd that broke in to see the ceremony performed. Thus arrived at the altar, and the priest in attendance, they waited a whole half-hour for the commodore, at whose slowness they began to be

[1] A travelled Frenchman (1537—1614), chamberlain to Charles IX. and Henry III. His *Mémoires* contain portraitures of the men and manners of his time.

under some apprehension, and accordingly dismissed a servant to quicken his pace. The valet having rode something more than a mile, espied the whole troop disposed in a long field, crossing the road obliquely, and headed by the bridegroom and his friend Hatchway, who finding himself hindered by a hedge from proceeding further in the same direction, fired a pistol, and stood over to the other side, making an obtuse angle with the line of his former course; and the rest of the squadron followed his example, keeping always in the rear of each other, like a flight of wild geese.

Surprised at this strange method of journeying, the messenger came up, and told the commodore that his lady and her company expected him in the church, where they had tarried a considerable time, and were beginning to be very uneasy at his delay; and therefore desired he would proceed with more expedition. To this message Mr Trunnion replied: 'Hark ye, brother, don't you see we make all possible speed? Go back and tell those who sent you that the wind has shifted since we weighed anchor, and that we are obliged to make very short trips in tacking, by reason of the narrowness of the channel; and that, as we lie within six points of the wind, they must make some allowance for variation and leeway.'—'Lord, sir!' said the valet, 'what occasion have you to go zigzag in that manner? Do but clap spurs to your horses, and ride straight forward, and I'll engage you shall be at the church-porch in less than a quarter of an hour.'—'What! right in the wind's eye?' answered the commander; 'ahey! brother, where did you learn your navigation? Hawser Trunnion is not to be taught at this time of day how to lie his course, or keep his own reckoning. And as for you, brother, you best know the trim of your own frigate.' The courier, finding he had to do with people who would not be easily persuaded out of their own opinions, returned to the temple, and made a report of what he had seen and heard, to the no small consolation of the bride, who had begun to discover some signs of disquiet. Composed, however, by this piece of intelligence, she exerted her patience for the space of another half-hour, during which period, seeing no bridegroom arrive, she was exceedingly alarmed; so that all the spectators could easily perceive her perturbation, which manifested itself in frequent palpitations, heart-heavings, and alterations of countenance, in spite of the assistance of a smelling-bottle which she incessantly applied to her nostrils.

Various were the conjectures of the company on this occasion: some imagined he had mistaken the place of rendezvous, as he had never been at church since he first settled in that parish; others believed he had met with some accident, in consequence of which his attendants had carried him back to his own house; and a third set, in which the bride herself was thought to be comprehended, could not help suspecting that the

commodore had changed his mind. But all these suppositions, ingenious as they were, happened to be wide of the true cause that detained him, which was no other than this: the commodore and his crew had, by dint of turning, almost weathered the parson's house that stood to windward of the church, when the notes of a pack of hounds unluckily reached the ears of the two hunters which Trunnion and the lieutenant bestrode. These fleet animals no sooner heard the enlivening sound, than, eager for the chase, they sprung away all of a sudden, and strained every nerve to partake of the sport, flew across the fields with incredible speed, overleaped hedges and ditches, and everything in their way, without the least regard to their unfortunate riders. The lieutenant, whose steed had got the heels of the other, finding it would be great folly and presumption in him to pretend to keep the saddle with his wooden leg, very wisely took the opportunity of throwing himself off in his passage through a field of rich clover, among which he lay at his ease; and seeing his captain advancing at full gallop, hailed him with the salutation of 'What cheer? ho!' The commodore, who was in infinite distress, eyeing him askance, as he passed, replied with a faltering voice: 'Oh, you are safe at anchor; I wish I were as fast moored.' Nevertheless, conscious of his disabled heel, he would not venture to try the experiment which had succeeded so well with Hatchway, but resolved to stick as close as possible to his horse's back, until Providence should interpose in his behalf. With this view, he dropped his whip, and with his right hand laid fast hold on the pommel, contracting every muscle in his body to secure himself in the seat, and grinning most formidably in consequence of this exertion. In this attitude, he was hurried on a considerable way, when all of a sudden his view was comforted by a five-bar gate that appeared before him, as he never doubted that there the career of his hunter must necessarily end. But, alas! he reckoned without his host; far from halting at this obstruction, the horse sprung over it with amazing agility, to the utter confusion and disorder of his owner, who lost his hat and periwig in the leap. He recommended himself to God, his reflection forsook him, his eyesight and all his other senses failed, he quitted the reins, and fastening by instinct on the mane, was in this condition conveyed into the midst of the sportsmen, who were astonished at the sight of such an apparition. Neither was their surprise to be wondered at, if we reflect on the figure that presented itself to their view. The commodore's person was at all times an object of admiration; much more so on this occasion, when every singularity was aggravated by the circumstances of his dress and disaster.

He had put on in honour of his nuptials his best coat of blue broadcloth, cut by a tailor of Ramsgate, and trimmed with five dozen of brass buttons, large and small; his breeches were of the same piece, fastened

at the knees with large bunches of tape; his waistcoat was of red plush lapelled with green velvet, and garnished with vellum holes; his boots bore an infinite resemblance, both in colour and shape, to a pair of leather buckets; his shoulder was graced with a broad buff belt, from whence depended a huge hanger with a hilt like that of a backsword; and on each side of his pommel appeared a rusty pistol rammed in a case covered with a bear-skin. The loss of his tie-periwig and laced hat, which were curiosities of the kind, did not at all contribute to the improvement of the picture, but on the contrary, by exhibiting his bald pate, and the natural extension of his lantern jaws, added to the peculiarity and extravagance of the whole. Such a spectacle could not have failed of diverting the whole company from the chase, had his horse thought proper to pursue a different route, but the beast was too keen a sporter to choose any other way than that which the stag followed; and therefore, without stopping to gratify the curiosity of the spectators, he in a few minutes outstripped every hunter in the field. There being a deep hollow way betwixt him and the hounds, rather than ride round about the length of a furlong to a path that crossed the lane, he transported himself at one jump, to the unspeakable astonishment and terror of a wagoner who chanced to be underneath, and saw this phenomenon fly over his carriage. This was not the only adventure he achieved. The stag having taken a deep river that lay in his way, every man directed his course to a bridge in the neighbourhood; but our bridegroom's courser, despising all such conveniences, plunged into the stream without hesitation, and swam in a twinkling to the opposite shore. This sudden immersion into an element of which Trunnion was properly a native, in all probability helped to recruit the exhausted spirits of his rider, who at his landing on the other side gave some tokens of sensation, by holloing aloud for assistance, which he could not possibly receive, because his horse still maintained the advantage he had gained, and would not allow himself to be overtaken.

In short, after a long chase that lasted several hours, and extended to a dozen miles at least, he was the first in at the death of the deer, being seconded by the lieutenant's gelding, which, actuated by the same spirit, had, without a rider, followed his companion's example. . . . .

By this time he and his two horses had engrossed the attention of the whole crowd: while some admired the elegant proportion and uncommon spirit of the two animals, the rest contemplated the surprising appearance of their master, whom before they had only seen *en passant;* and at length one of the gentlemen, accosting him very courteously, signified his wonder at seeing him in such an equipage, and asked if he had not dropped his companion by the way. 'Why, look ye, brother,' replied the commodore, 'mayhap you think me an odd sort of a fellow, seeing me in

this trim, especially as I have lost part of my rigging; but this here is the case, d'ye see: I weighed anchor from my own house this morning at ten A.M., with fair weather, and a favourable breeze at south-south-east, being bound to the next church on the voyage of matrimony: but howsomever, we had not run down a quarter of a league, when the wind shifting blowed directly in our teeth; so that we were forced to tack all the way, d'ye see, and had almost beat up within sight of the port, when these horses, which I had bought but two days before, luffed round in a trice, and then refusing the helm, drove away like lightning with me and my lieutenant, who soon came to anchor in an exceeding good berth. As for my own part, I have been carried over rocks, and flats, and quicksands; among which I have pitched away a special good tie-periwig and an iron-bound hat; and at last, thank God! am got into smooth water and safe riding: but if ever I venture my carcass upon such a harum-scarum blood again, my name is not Hawser Trunnion!'

Oliver Goldsmith: 1728–1774.

A City Night-piece.—From 'The Citizen of the World.'

The clock has just struck two; the expiring taper rises and sinks in the socket; the watchman forgets the hour in slumber; the laborious and the happy are at rest; and nothing wakes but meditation, guilt, revelry, and despair. The drunkard once more fills the destroying bowl; the robber walks his midnight round; and the suicide lifts his guilty arm against his own sacred person.

Let me no longer waste the night over the page of antiquity or the sallies of contemporary genius, but pursue the solitary walk, where vanity, ever changing, but a few hours past walked before me—where she kept up the pageant, and now, like a froward child, seems hushed with her own importunities.

What a gloom hangs all around! The dying lamp feebly emits a yellow gleam; no sound is heard but of the chiming clock or the distant watch-dog; all the bustle of human pride is forgotten. An hour like this may well display the emptiness of human vanity.

There will come a time when this temporary solitude will be made continual, and the city itself, like its inhabitants, fade away, and leave a desert in its room.

What cities, great as this, have once triumphed in existence, had their victories as great, joy as just and as unbounded, and, with short-sighted presumption, promised themselves immortality! Posterity can hardly trace the situation of some; the sorrowful traveller wanders over the

awful ruins of others; and, as he beholds, he learns wisdom, and feels the transience of every sublunary possession.

Here, he cries, stood their citadel, now grown over with weeds; there their senate-house, but now the haunt of every noxious reptile. Temples and theatres stood here, now only an undistinguished heap of ruin. They are fallen, for luxury and avarice first made them feeble. The rewards of state were conferred on amusing, and not on useful members of society. Their riches and opulence invited the invaders, who, though at first repulsed, returned again, conquered by perseverance, and at last swept the defendants into undistinguished destruction.

How few appear in those streets, which but some few hours ago were crowded! And those who appear, now no longer wear their daily mask, nor attempt to hide their lewdness or their misery.

But who are those who make the streets their couch, and find a short repose from wretchedness at the doors of the opulent? These are strangers, wanderers, and orphans, whose circumstances are too humble to expect redress, and whose distresses are too great even for pity. Their wretchedness excites rather horror than pity. Some are without the covering even of rags, and others emaciated with disease. The world has disclaimed them: society turns its back upon their distress, and has given them up to nakedness and hunger. These poor shivering females have once seen happier days, and been flattered into beauty.

Why, why was I born a man, and yet see the sufferings of wretches I cannot relieve? Poor houseless creatures! the world will give you reproaches, but will not give you relief. The slightest misfortunes of the great, the most imaginary uneasiness of the rich, are aggravated with all the power of eloquence, and held up to engage our attention and sympathetic sorrow. The poor weep unheeded, persecuted by every subordinate species of tyranny; and every law which gives others security becomes an enemy to them.

Why was this heart of mine formed with so much sensibility; or why was not my fortune adapted to its impulses? Tenderness without the capacity of relieving, only makes the man more wretched than the object which sues for assistance.

Edward Gibbon: 1737–1794.

The City of Bagdad—Magnificence of the Caliphs.—From the 'Decline and Fall of the Roman Empire.'

Almansor, the brother and successor of Saffah, laid the foundations of Bagdad (762 A.D.), the imperial seat of his posterity during a reign of five hundred years. The chosen spot is on the eastern bank of the Tigris,

about fifteen miles above the ruins of Modain: the double wall was of a circular form; and such was the rapid increase of a capital now dwindled to a provincial town, that the funeral of a popular saint might be attended by eight hundred thousand men and sixty thousand women of Bagdad and the adjacent villages. In this city of peace, amidst the riches of the East, the Abbasides[1] soon disdained the abstinence and frugality of the first caliphs, and aspired to emulate the magnificence of the Persian kings. After his wars and buildings, Almansor left behind him in gold and silver about thirty millions sterling; and this treasure was exhausted in a few years by the vices or virtues of his children. His son Mahadi, in a single pilgrimage to Mecca, expended six millions of dinars[2] of gold. A pious and charitable motive may sanctify the foundation of cisterns and caravansaries, which he distributed along a measured road of seven hundred miles; but his train of camels, laden with snow, could serve only to astonish the natives of Arabia, and to refresh the fruits and liquors of the royal banquet. The courtiers would surely praise the liberality of his grandson Almamon, who gave away four-fifths of the income of a province—a sum of two millions four hundred thousand gold dinars—before he drew his foot from the stirrup. At the nuptials of the same prince, a thousand pearls of the largest size were showered on the head of the bride, and a lottery of lands and houses displayed the capricious bounty of fortune. The glories of the court were brightened rather than impaired in the decline of the empire, and a Greek ambassador might admire or pity the magnificence of the feeble Moctader. 'The caliph's whole army,' says the historian Abulfeda, 'both horse and foot, was under arms, which together made a body of one hundred and sixty thousand men. His state-officers, the favourite slaves, stood near him in splendid apparel, their belts glittering with gold and gems. Near them were seven thousand eunuchs, four thousand of them white, the remainder black. The porters or door-keepers were in number seven hundred. Barges and boats, with the most superb decorations, were seen swimming upon the Tigris. Nor was the palace itself less splendid, in which were hung up thirty-eight thousand pieces of tapestry, twelve thousand five hundred of which were of silk embroidered with gold. The carpets on the floor were twenty-two thousand. A hundred lions were brought out, with a keeper to each lion. Among the other spectacles of rare and stupendous luxury, was a tree of gold and silver spreading into eighteen large branches, on which, and on the lesser boughs, sat a variety of birds made of the same precious metals, as well as the leaves of the tree. While the machinery affected spontaneous motions, the several birds warbled their natural harmony. Through this scene of magnificence the Greek ambassador was

[1] Descendants of Abbas, uncle of Mohammed, the Arabian prophet. [2] A Persian coin.

led by the vizier to the foot of the caliph's throne.' In the West, the Ommiades[1] of Spain supported, with equal pomp, the title of commander of the faithful. Three miles from Cordova, in honour of his favourite sultana, the third and greatest of the Abdalrahmans constructed the city, palace, and gardens of Zehra. Twenty-five years, and above three millions sterling, were employed by the founder: his liberal taste invited the artists of Constantinople, the most skilful sculptors and architects of the age; and the buildings were sustained or adorned by twelve hundred columns of Spanish and African, of Greek and Italian marble. The hall of audience was incrusted with gold and pearls, and a great basin in the centre was surrounded with the curious and costly figures of birds and quadrupeds. In a lofty pavilion of the gardens, one of these basins and fountains, so delightful in a sultry climate, was replenished not with water, but with the purest quicksilver. The seraglio of Abdalrahman, his wives, concubines, and black eunuchs, amounted to six thousand three hundred persons; and he was attended to the field by a guard of twelve thousand horse, whose belts and scimitars were studded with gold.

In a private condition, our desires are perpetually repressed by poverty and subordination; but the lives and labours of millions are devoted to the service of a despotic prince, whose laws are blindly obeyed, and whose wishes are instantly gratified. Our imagination is dazzled by the splendid picture; and whatever may be the cool dictates of reason, there are few among us who would obstinately refuse a trial of the comforts and the cares of royalty. It may therefore be of some use to borrow the experience of the same Abdalrahman, whose magnificence has perhaps excited our admiration and envy, and to transcribe an authentic memorial which was found in the closet of the deceased caliph. 'I have now reigned above fifty years in victory or peace; beloved by my subjects, dreaded by my enemies, and respected by my allies. Riches and honours, power and pleasure, have waited on my call, nor does any earthly blessing appear to have been wanting to my felicity. In this situation I have diligently numbered the days of pure and genuine happiness which have fallen to my lot: they amount to fourteen. O man! place not thy confidence in this present world.'

Edmund Burke: 1730–1797.

Hyder Ali's Devastation of the Carnatic.—From his 'Speech on the Nabob of Arcot's Debts.'

When at length Hyder Ali found that he had to do with men who either would sign no convention, or whom no treaty and no signature

[1] Arab rulers of Spain, so called from Ommeyah, their ancestor.

could bind, and who were the determined enemies of human intercourse itself, he decreed to make the country possessed by these incorrigible and predestinated criminals a memorable example to mankind. He resolved, in the gloomy recesses of a mind capacious of such things, to leave the whole Carnatic an everlasting monument of vengeance, and to put perpetual desolation as a barrier between him and those, against whom the faith which holds the moral elements of the world together was no protection. He became at length so confident of his force, so collected in his might, that he made no secret whatsoever of his dreadful resolution. Having terminated his disputes with every enemy and every rival, who buried their mutual animosities in their common detestation against the creditors of the Nabob of Arcot, he drew from every quarter whatever a savage ferocity could add to his new rudiments in the arts of destruction; and compounding all the materials of fury, havoc, and desolation into one black cloud, he hung for a while on the declivities of the mountains. Whilst the authors of all these evils were idly and stupidly gazing on this menacing meteor, which blackened all their horizon, it suddenly burst, and poured down the whole of its contents upon the plains of the Carnatic. Then ensued a scene of woe, the like of which no eye had seen, no heart conceived, and which no tongue can adequately tell. All the horrors of war before known or heard of, were mercy to that new havoc. A storm of universal fire blasted every field, consumed every house, destroyed every temple. The miserable inhabitants flying from their flaming villages, in part were slaughtered; others, without regard to sex, to age, to the respect of rank or sacredness of function, fathers torn from children, husbands from wives, enveloped in a whirlwind of cavalry, and amidst the goading spears of drivers, and the trampling of pursuing horses, were swept into captivity in an unknown and hostile land. Those who were able to evade this tempest, fled to the walled cities. But escaping from fire, sword, and exile, they fell into the jaws of famine.

The alms of the settlement, in this dreadful exigency, were certainly liberal; and all was done by charity that private charity could do: but it was a people in beggary—it was a nation which stretched out its hands for food. For months together these creatures of sufferance, whose very excess and luxury in their most plenteous days had fallen short of the allowance of our austerest fasts, silent, patient, resigned, without sedition or disturbance, almost without complaint, perished by a hundred a day in the streets of Madras; every day seventy at least laid their bodies in the streets, or on the glacis of Tanjore, and expired of famine in the granary of India. I was going to awake your justice towards this unhappy part of our fellow-citizens, by bringing before you some of the circumstances of this plague of hunger. Of all the calamities which beset and waylay the life of man, this comes the nearest to our heart, and is that

wherein the proudest of us all feels himself to be nothing more than he is; but I find myself unable to manage it with decorum: these details are of a species of horror so nauseous and disgusting; they are so degrading to the sufferers and to the hearers; they are so humiliating to human nature itself, that, on better thoughts, I find it more advisable to throw a pall over this hideous object, and to leave it to your general conceptions.

For eighteen months, without intermission, this destruction raged from the gates of Madras to the gates of Tanjore; and so completely did these masters in their art, Hyder Ali, and his more ferocious son, absolve themselves of their impious vow, that when the British armies traversed, as they did, the Carnatic for hundreds of miles in all directions, through the whole line of their march they did not see one man, not one woman, not one child, not one four-footed beast of any description whatever! One dead uniform silence reigned over the whole region. With the inconsiderable exceptions of the narrow vicinage of some few forts, I wish to be understood as speaking literally; I mean to produce to you more than three witnesses, above all exception, who will support this assertion in its full extent. That hurricane of war passed through every part of the central provinces of the Carnatic. Six or seven districts to the north and to the south (and these not wholly untouched) escaped the general ravage.

The Carnatic is a country not much inferior in extent to England. Figure to yourself, Mr Speaker, the land in whose representative chair you sit; figure to yourself the form and fashion of your sweet and cheerful country from Thames to Trent, north and south, and from the Irish to the German Sea, east and west, emptied and embowelled (may God avert the omen of our crimes!) by so accomplished a desolation. Extend your imagination a little further, and then suppose your ministers taking a survey of this scene of waste and desolation; what would be your thoughts if you should be informed, that they were computing how much had been the amount of the excises, how much the customs, how much the land and malt tax, in order that they should charge (take it in the most favourable light) for public service, upon the relics of the satiated vengeance of relentless enemies, the whole of what England had yielded in the most exuberant seasons of peace and abundance? What would you call it? To call it tyranny, sublimed into madness, would be too faint an image; yet this very madness is the principle upon which the ministers at your right hand have proceeded in their estimate of the revenues of the Carnatic, when they were providing, not supply for the establishments of its protection, but rewards for the authors of its ruin.

Robert Hall: 1764–1831.

From 'The Funeral Sermon for the Princess Charlotte of Wales.'

Born to inherit the most illustrious monarchy in the world, and united at an early period to the object of her choice, whose virtues amply justified her preference, she enjoyed (what is not always the privilege of that rank) the highest connubial felicity, and had the prospect of combining all the tranquil enjoyments of private life with the splendour of a royal station. Placed on the summit of society, to her every eye was turned, in her every hope was centered, and nothing was wanting to complete her felicity except perpetuity. To a grandeur of mind suited to her royal birth and lofty destination, she joined an exquisite taste for the beauties of nature and the charms of retirement, where, far from the gaze of the multitude, and the frivolous agitations of fashionable life, she employed her hours in visiting, with her distinguished consort, the cottages of the poor, in improving her virtues, in perfecting her reason, and acquiring the knowledge best adapted to qualify her for the possession of power and the cares of empire. One thing only was wanting to render our satisfaction complete in the prospect of the accession of such a princess; it was, that she might become the living mother of children.

The long-wished-for moment at length arrived; but, alas! the event anticipated with such eagerness will form the most melancholy part of our history.

It is no reflection on this amiable princess to suppose that in her early dawn, with the dew of her youth so fresh upon her, she anticipated a long series of years, and expected to be led through successive scenes of enchantment, rising above each other in fascination and beauty. It is natural to suppose she identified herself with this great nation which she was born to govern; and that, while she contemplated its pre-eminent lustre in arts and in arms, its commerce encircling the globe, its colonies diffused through both hemispheres, and the beneficial effects of its institutions extending to the whole earth, she considered them as so many component parts of her grandeur. Her heart, we may well conceive, would often be ruffled with emotions of trembling ecstasy when she reflected that it was her province to live entirely for others, to compass the felicity of a great people, to move in a sphere which would afford scope for the exercise of philanthropy the most enlarged, of wisdom the most enlightened; and that, while others are doomed to pass through the world in obscurity, she was to supply the materials of history, and to impart that impulse to society which was to decide the destiny of future generations. Fired with the ambition of equalling or surpassing the most distinguished of her predecessors, she probably did not despair of reviving the remembrance

of the brightest parts of their story, and of once more attaching the epoch of British glory to the annals of a female reign. It is needless to add that the nation went with her, and probably outstripped her in these delightful anticipations. We fondly hoped that a life so inestimable would be protracted to a distant period, and that, after diffusing the blessings of a just and enlightened administration, and being surrounded by a numerous progeny, she would gradually, in a good old age, sink under the horizon amidst the embraces of her family and the benedictions of her country. But, alas! these delightful visions are fled; and what do we behold in their room but the funeral-pall and shroud, a palace in mourning, a nation in tears, and the shadow of death settled over both like a cloud! Oh the unspeakable vanity of human hopes!—the incurable blindness of man to futurity!—ever doomed to grasp at shadows; 'to seize' with avidity what turns to dust and ashes in his hands; to sow the wind, and reap the whirlwind.

Sydney Smith: 1768–1845.

Modern Changes.

'The good of ancient times let others state,
I think it lucky I was born so late.'

Mr Editor—It is of some importance at what period a man is born. A young man, alive at this period, hardly knows to what improvements of human life he has been introduced; and I would bring before his notice the following eighteen changes which have taken place in England since I first began to breathe in it the breath of life—a period amounting now to nearly seventy-three years.

Gas was unknown: I groped about the streets of London in all but the utter darkness of a twinkling oil lamp, under the protection of watchmen in their grand climacteric, and exposed to every species of depredation and insult.

I have been nine hours in sailing from Dover to Calais before the invention of steam. It took me nine hours to go from Taunton to Bath, before the invention of railroads, and I now go in six hours from Taunton to London! In going from Taunton to Bath, I suffered between ten and twelve thousand severe contusions, before stone-breaking Macadam was born.

I paid fifteen pounds in a single year for repairs of carriage-springs on the pavement of London; and I now glide without noise or fracture, on wooden pavements.

I can walk, by the assistance of the police, from one end of London to the other, without molestation; or, if tired, get into a cheap and active

cab, instead of those cottages on wheels, which the hackney coaches were at the beginning of my life.

I had no umbrella! They were little used, and very dear. There were no waterproof hats, and my hat has often been reduced by rains into its primitive pulp.

I could not keep my smallclothes in their proper place, for braces were unknown. If I had the gout, there was no colchicum. If I was bilious, there was no calomel. If I was attacked by ague, there was no quinine. There were filthy coffee-houses instead of elegant clubs. Game could not be bought. Quarrels about uncommuted tithes were endless. The corruption of Parliament, before Reform, infamous. There were no banks to receive the savings of the poor. The poor-laws were gradually sapping the vitals of the country; and whatever miseries I suffered, I had no post to whisk my complaints for a single penny to the remotest corners of the empire; and yet, in spite of all these privations, I lived on quietly, and am now ashamed that I was not more discontented, and utterly surprised that all these changes and inventions did not occur two centuries ago.

Z.

I forgot to add, that as the basket of stage-coaches, in which luggage was then carried, had no springs, your clothes were rubbed all to pieces; and that even in the best society one-third of the gentlemen at least were always drunk.

Conspiracy of the Pope.—From 'Peter Plymley's Letters.'

The pope has not landed—nor are there any curates sent out after him—nor has he been hid at St Albans by the Dowager Lady Spencer—nor dined privately at Holland House—nor been seen near Dropmore. If these fears exist (which I do not believe), they exist only in the mind of the Chancellor of the Exchequer [the late Mr Spencer Perceval]; they emanate from his zeal for the Protestant interest; and though they reflect the highest honour upon the delicate irritability of his faith, must certainly be considered as more ambiguous proofs of the sanity and vigour of his understanding. By this time, however, the best-informed clergy in the neighbourhood of the metropolis are convinced that the rumour is without foundation: and though the pope is probably hovering about our coast in a fishing-smack, it is most likely he will fall a prey to the vigilance of the cruisers: and it is certain he has not yet polluted the Protestantism of our soil. Exactly in the same manner the story of the wooden gods seized at Charing Cross, by an order from the Foreign Office, turns out to be without the shadow of a foundation: instead of the angels and archangels mentioned by the informer, nothing was discovered but a wooden

image of Lord Mulgrave going down to Chatham as a headpiece for the *Spanker* gun-vessel: it was an exact resemblance of his lordship in his military uniform; and therefore as little like a god as can well be imagined.

Sir Walter Scott: 1771–1832.

The Siege.—From 'Ivanhoe.'

[Described by Rebecca to Ivanhoe lying wounded.]

'And I must lie here like a bedridden monk,' exclaimed Ivanhoe, 'while the game that gives me freedom or death is played out by the hand of others!—Look from the window once again, kind maiden, but beware that you are not marked by the archers beneath—Look out once more, and tell me if they yet advance to the storm.'

With patient courage, strengthened by the interval which she had employed in mental devotion, Rebecca again took post at the lattice, sheltering herself, however, so as not to be visible from beneath.

'What dost thou see, Rebecca?' again demanded the wounded knight.

'Nothing but the cloud of arrows flying so thick as to dazzle mine eyes, and to hide the bowmen who shoot them.'

'That cannot endure,' said Ivanhoe; 'if they press not right on to carry the castle by pure force of arms, the archery may avail but little against stone walls and bulwarks. Look for the Knight of the Fetterlock, fair Rebecca, and see how he bears himself; for as the leader is, so will his followers be.'

'I see him not,' said Rebecca.

'Foul craven!' exclaimed Ivanhoe; 'does he blench from the helm when the wind blows highest?'

'He blenches not! he blenches not!' said Rebecca: 'I see him now; he leads a body of men close under the outer barrier of the barbican.—They pull down the piles and palisades; they hew down the barriers with axes.—His high black plume floats abroad over the throng, like a raven over the field of the slain.—They have made a breach in the barriers—they rush in—they are thrust back!—Front-de-Bœuf heads the defenders; I see his gigantic form above the press. They throng again to the breach, and the pass is disputed hand to hand, and man to man. God of Jacob! it is the meeting of two fierce tides—the conflict of two oceans moved by adverse winds!'

She turned her head from the lattice, as if unable longer to endure a sight so terrible.

'Look forth again, Rebecca,' said Ivanhoe, mistaking the cause of her retiring; 'the archery must in some degree have ceased, since they are now fighting hand to hand.—Look again; there is now less danger.'

Rebecca again looked forth, and almost immediately exclaimed: 'Holy prophets of the law! Front-de-Bœuf and the Black Knight fight hand to hand on the breach, amid the roar of their followers, who watch the progress of the strife.—Heaven strike with the cause of the oppressed and of the captive!' She then uttered a loud shriek, and exclaimed: 'He is down!—he is down!'

'Who is down?' cried Ivanhoe; 'for our dear Lady's sake, tell me which has fallen?'

'The Black Knight,' answered Rebecca faintly; then instantly again shouted with joyful eagerness: 'But no—but no!—the name of the Lord of Hosts be blessed!—he is on foot again, and fights as if there were twenty men's strength in his single arm.—His sword is broken—he snatches an axe from a yeoman—he presses Front-de-Bœuf with blow on blow.—The giant stoops and totters like an oak under the steel of the woodman—he falls—he falls!'

'Front-de-Bœuf?' exclaimed Ivanhoe.

'Front-de-Bœuf!' answered the Jewess; 'his men rush to the rescue, headed by the haughty Templar—their united force compels the champion to pause—They drag Front-de-Bœuf within the walls.'

'The assailants have won the barriers, have they not?' said Ivanhoe.

'They have—they have!' exclaimed Rebecca; 'and they press the besieged hard upon the outer wall; some plant ladders, some swarm like bees, and endeavour to ascend upon the shoulders of each other; down go stones, beams, and trunks of trees upon their heads, and as fast as they bear the wounded to the rear, fresh men supply their places in the assault—Great God! hast thou given men thine own image, that it should be thus cruelly defaced by the hands of their brethren!'

'Think not of that,' said Ivanhoe; 'this is no time for such thoughts.—Who yield?—who push their way?'

'The ladders are thrown down,' replied Rebecca, shuddering; 'the soldiers lie grovelling under them like crushed reptiles.—The besieged have the better.'

'Saint George strike for us!' exclaimed the knight; 'do the false yeomen give way?'

'No!' exclaimed Rebecca, 'they bear themselves right yeomanly—the Black Knight approaches the postern with his huge axe—the thundering blows which he deals, you may hear them above all the din and shouts of the battle.—Stones and beams are hailed down on the bold champion—he regards them no more than if they were thistle-down or feathers!'

'By Saint John of Acre,' said Ivanhoe, raising himself joyfully on his couch, 'methought there was but one man in England that might do such a deed!'

'The postern gate shakes,' continued Rebecca; 'it crashes—it is

splintered by his blows—they rush in—the outwork is won.—O God! —they hurl the defenders from the battlements—they throw them into the moat.—O men, if ye be indeed men, spare them that can resist no longer!'

'The bridge—the bridge which communicates with the castle—have they won that pass?' exclaimed Ivanhoe.

'No,' replied Rebecca, 'the Templar has destroyed the plank on which they crossed—few of the defenders escaped with him into the castle—the shrieks and cries which you hear tell the fate of the others.—Alas! I see it is still more difficult to look upon victory than upon battle.'

Samuel Taylor Coleridge: 1772–1834.

Advantage of Method.—From 'The Friend.'

What is that which first strikes us, and strikes us at once in a man of education; and which, among educated men, so instantly distinguishes the man of superior mind, that (as was observed with eminent propriety of the late Edmund Burke) 'we cannot stand under the same archway during a shower of rain without finding him out?' Not the weight or novelty of his remarks; not any unusual interest of facts communicated by him; for we may suppose both the one and the other precluded by the shortness of our intercourse and the triviality of the subjects. The difference will be impressed and felt though the conversation should be confined to the state of the weather or the pavement. Still less will it arise from any peculiarity in his words and phrases; for if he be, as we now assume, a *well*-educated man, as well as a man of superior powers, he will not fail to follow the golden rule of Julius Cæsar, and, unless where new things necessitate new terms, he will avoid an unusual word as a rock. It must have been among the earliest lessons of his youth that the breach of this precept, at all times hazardous, becomes ridiculous in the topics of ordinary conversation. There remains but one other point of distinction possible; and this must be, and in fact is, the true cause of the impression made on us. It is the unpremeditated and evidently habitual *arrangement* of his words, grounded on the habit of foreseeing, in each integral part, or (more plainly) in every sentence, the whole that he then intends to communicate. However irregular and desultory his talk, there is METHOD in the fragments.

Listen, on the other hand, to an ignorant man, though perhaps shrewd and able in his particular calling; whether he be describing or relating. We immediately perceive that his memory alone is called into action, and that the objects and events recur in the narration in the same order, and with the same accompaniments, however accidental or impertinent,

as they had first occurred to the narrator. The necessity of taking breath, the efforts of recollection, and the abrupt rectification of its failures, produce all his pauses, and, with the exception of the '*and then*,' the '*and there*,' and the still less significant '*and so*,' they constitute likewise all his connections. Our discussion, however, is confined to method, as employed in the formation of the understanding and in the constructions of science and literature. It would indeed be superfluous to attempt a proof of its importance in the business and economy of active or domestic life. From the cotter's hearth or the workshop of the artisan, to the palace or the arsenal, the first merit, that which admits neither substitute nor equivalent, is, that *everything is in its place*. Where this charm is wanting, every other merit either loses its name or becomes an additional ground of accusation and regret. Of one by whom it is eminently possessed, we say proverbially he is like clockwork. The resemblance extends beyond the point of regularity, and yet falls short of the truth. Both do, indeed, at once divide and announce the silent and otherwise indistinguishable lapse of time. But the man of methodical industry and honourable pursuits does more: he realises its ideal divisions, and gives a character and individuality to its moments. If the idle are described as killing time, he may be justly said to call it into life and moral being, while he makes it the distinct object not only of the consciousness, but of the conscience. He organises the hours, and gives them a soul; and that, the very essence of which is to fleet away, and evermore *to have been*, he takes up into his own permanence, and communicates to it the imperishableness of a spiritual nature. Of the good and faithful servant whose energies, thus directed, are thus methodised, it is less truly affirmed that he lives in time than that time lives in him. His days, months, and years, as the stops and punctual marks in the records of duties performed, will survive the wreck of worlds, and remain extant when time itself shall be no more.

Charles Lamb: 1775–1836.

Thoughts on Books.—From the 'Essays of Elia.'

'To mind the inside of a book, is to entertain one's-self with the forced product of another man's brain. Now I think a man of quality and breeding may be much amused with the natural sprouts of his own.'—LORD FOPPINGTON, *in the 'Relapse.'*

An ingenious acquaintance of my own was so much struck with this bright sally of his lordship, that he has left off reading altogether, to the great improvement of his originality. At the hazard of losing some credit on this head, I must confess that I dedicate no inconsiderable portion of

my time to other people's thoughts. I dream away my life in others' speculations. I love to lose myself in other men's minds. When I am not walking I am reading; I cannot sit and think: books think for me. I have no repugnances. Shaftesbury is not too genteel for me, nor Jonathan Wild too low. I can read anything which I call a *book*. There are things in that shape which I cannot allow for such. In this catalogue of '*books which are no books*,' I reckon Court Calendars, Directories, Pocket-books, Draught-boards bound and lettered on the back, Scientific Treatises, Almanacks, Statutes at Large; the works of Hume, Gibbon, Robertson, Beattie, Soame Jenyns—and, generally, all those volumes which 'no gentleman's library should be without;' the histories of Flavius Josephus (that learned Jew), and Paley's *Moral Philosophy*. With these exceptions, I can read almost anything. I bless my stars for a taste so catholic, so unexcluding.

I confess that it moves my spleen to see these 'things in books' clothing' perched upon shelves, like false saints, usurpers of true shrines, intruders into the sanctuary, thrusting out the legitimate occupants. To reach down a well-bound semblance of a volume, and hope it some kind-hearted play-book, then, opening what 'seem its leaves,' to come bolt upon a withering Population Essay. To expect a Steele or a Farquhar, and find Adam Smith. To view a well-arranged assortment of blockheaded Encyclopædias (Anglicanas or Metropolitanas), set out in an array of russia or morocco, when a tithe of that good leather would comfortably reclothe my shivering folios; would renovate Paracelsus himself, and enable old Raymond Lully to look like himself again in the world. I never see these impostors but I long to strip them, to warm my ragged veterans in their spoils.

To be strong-backed and neat-bound, is the desideratum of a volume; magnificence comes after. This, when it can be afforded, is not to be lavished upon all kinds of books indiscriminately. I would not dress a set of magazines, for instance, in full suit. The déshabillé, or half-binding (with russia backs for ever) is *their* costume. A Shakspeare or a Milton (unless the first editions) it were mere foppery to trick out in gay apparel. The possession of them confers no distinction. The exterior of them (the things themselves being so common), strange to say, raises no sweet emotions, no tickling sense of property, in the owner. Thomson's *Seasons*, again, looks best (I maintain it) a little torn and dog's-eared. How beautiful, to a genuine lover of reading, are the sullied leaves and worn-out appearance, nay, the very odour (beyond russia), of an old circulating-library *Tom Jones* or *Vicar of Wakefield!* How they speak of the thousand thumbs that have turned over their pages with delight! of the lone sempstress whom they may have cheered (milliner, or harder-working mantua-maker) after her long day's needle toil, running far into midnight, when she has snatched an hour, ill spared from sleep, to steep her cares,

as in some Lethean cup, in spelling out their enchanting contents! Who would have them a whit less soiled? What better condition could we desire to see them in? . . . .

Shall I be thought fantastical if I confess that the names of some of our poets sound sweeter, and have a finer relish to the ear, to mine, at least, than that of Milton or Shakspeare? It may be that the latter are more staled and run upon in common discourse. The sweetest names, and which carry a perfume in the mention, are Kit Marlowe, Drayton, Drummond of Hawthornden, and Cowley.

Francis Jeffrey: 1773–1850.

Style of the Literature during the reign of Queen Anne: its Rise and Decline. —From a Review of Swift's Works in the 'Edinburgh Review,' 1816.

It was the unfortunate ambition of the next generation of authors [those of the time of Queen Anne], to improve and perfect the new style [of the Reformation] rather than to return to the old one; and it cannot be denied that they did improve it. They corrected its gross indecency—increased its precision and correctness—made its pleasantry and sarcasm more polished and elegant—and spread through the whole of its irony, its narration, and its reflection, a tone of clear and condensed good sense, which recommended itself to all who had, and all who had not any relish for higher beauties.

This is the praise of Queen Anne's wits—and to this praise they are justly entitled. This was left for them to do, and they did it well. They were invited to it by the circumstances of their situation, and do not seem to have been possessed of any such bold or vigorous spirit, as either to neglect or to outgo the invitation. Coming into life immediately after the consummation of a bloodless revolution, effected much more by the cool sense than the angry passions of the nation, they seem to have felt that they were born in an age of reason, rather than of feeling or fancy; and that men's minds, though considerably divided and unsettled upon many points, were in a much better temper to relish judicious argument and cutting satire, than the glow of enthusiastic passion, or the richness of a luxuriant imagination. To those accordingly they made no pretensions; but, writing with infinite good sense, and great grace and vivacity, and, above all, writing for the first time in a tone that was peculiar to the upper ranks of society, and upon subjects that were almost exclusively interesting to them, they naturally figured, at least while the manner was new, as the most accomplished, fashionable, and perfect writers which the world had ever seen; and made the wild, luxuriant, and humble sweetness of our

earlier authors appear rude and untutored in the comparison. Men grew ashamed of admiring, and afraid of imitating, writers of so little skill and smartness; and the opinion became general, not only that their faults were intolerable, but that even their beauties were puerile and barbarous, and unworthy the serious regard of a polite and distinguishing age.

These and similar considerations will go far to account for the celebrity which those authors acquired in their day; but it is not quite so easy to explain how they should have so long retained their ascendant. One cause undoubtedly was, the real excellence of their productions, in the style which they had adopted. It was hopeless to think of surpassing them in that style; and, recommended as it was by the felicity of their execution, it required some courage to depart from it, and to recur to another, which seemed to have been so lately abandoned for its sake. The age which succeeded, too, was not the age of courage or adventure. There never was, on the whole, a quieter time than the reigns of the first two Georges, and the greater part of that which ensued. There were two little provincial rebellions indeed, and a fair proportion of foreign war; but there was nothing to stir the minds of the people at large, to rouse their passions, or excite their imaginations—nothing like the agitations of the Reformation in the sixteenth century, or of the civil wars in the seventeenth. They went on, accordingly, minding their old business, and reading their old books, with great patience and stupidity: and certainly there never was so remarkable a dearth of original talent—so long an *interregnum* of native genius—as during about sixty years in the middle of the last century. The dramatic art was dead fifty years before—and poetry seemed verging to a similar extinction. The few sparks that appeared, too, shewed that the old fire was burned out, and that the altar must hereafter be heaped with fuel of another quality. Gray, with the talents rather of a critic than a poet—with learning, fastidiousness, and scrupulous delicacy of taste, instead of fire, tenderness, or invention—began and ended a small school, which we could scarcely have wished to become permanent, admirable in many respects as some of its productions are—being far too elaborate and artificial, either for grace or for fluency, and fitter to excite the admiration of scholars than the delight of ordinary men. However, he had the merit of not being in any degree French, and of restoring to our poetry the dignity of seriousness, and the tone at least of force and energy. The Whartons, both as critics and as poets, were of considerable service in discrediting the high pretensions of the former race, and in bringing back to public notice the great stores and treasures of poetry which lay hid in the records of our older literature. Akenside attempted a sort of classical and philosophical rapture, which no elegance of language could easily have rendered popular, but which had merits of no vulgar order for those who could study it. Goldsmith wrote with

perfect elegance and beauty, in a style of mellow tenderness and elaborate simplicity. He had the harmony of Pope without his quaintness, and his selectness of diction without his coldness and eternal vivacity. And, last of all, came Cowper, with a style of complete originality; and, for the first time, made it apparent to readers of all descriptions, that Pope and Addison were no longer to be the models of English poetry.

In philosophy and prose writing in general the case was nearly parallel. The name of Hume is by far the most considerable which occurs in the period to which we have alluded. But, though his thinking was English, his style is entirely French; and being naturally of a cold fancy, there is nothing of that eloquence or richness about him which characterises the writings of Taylor, and Hooker, and Bacon—and continues, with less weight of matter, to please in those of Cowley and Clarendon. Warburton had great powers; and wrote with more force and freedom than the wits to whom he succeeded—but his faculties were perverted by a paltry love of paradox, and rendered useless to mankind by an unlucky choice of subjects, and the arrogance and dogmatism of his temper. Adam Smith was nearly the first who made deeper reasonings and more exact knowledge popular among us; and Junius and Johnson the first who again familiarised us with more glowing and sonorous diction—and made us feel the tameness and poorness of the serious style of Addison and Swift.

Washington Irving: 1783—1859.

Visit to Henry the Seventh's Chapel in Westminster Abbey.—From 'The Sketch-book.'

The day was gradually wearing away; the distant tread of loiterers about the abbey grew less and less frequent; the sweet-tongued bell was summoning to evening prayers; and I saw at a distance the choristers, in their white surplices, crossing the aisle and entering the choir. I stood before the entrance to Henry the Seventh's chapel. A flight of steps lead up to it, through a deep and gloomy, but magnificent arch. Great gates of brass, richly and delicately wrought, turn heavily upon their hinges, as if proudly reluctant to admit the feet of common mortals into this most gorgeous of sepulchres.

On entering, the eye is astonished by the pomp of architecture, and the elaborate beauty of sculptured detail. The very walls are wrought into universal ornament, incrusted with tracery, and scooped into niches, crowded with the statues of saints and martyrs. Stone seems, by the cunning labour of the chisel, to have been robbed of its weight and density, suspended aloft, as if by magic, and the fretted roof achieved with the wonderful minuteness and airy security of a cobweb.

Along the sides of the chapel are the lofty stalls of the Knights of the Bath, richly carved of oak, though with the grotesque decorations of Gothic architecture. On the pinnacles of the stalls are affixed the helmets and crests of the knights, with their scarfs and swords; and above them are suspended their banners, emblazoned with armorial bearings, and contrasting the splendour of gold and purple and crimson with the cold gray fretwork of the roof. In the midst of this grand mausoleum stands the sepulchre of its founder—his effigy, with that of his queen, extended on a sumptuous tomb, and the whole surrounded by a superbly wrought brazen railing.

There is a sad dreariness in this magnificence; this strange mixture of tombs and trophies; these emblems of living and aspiring ambition, close beside mementos which shew the dust and oblivion in which all must sooner or later terminate. Nothing impresses the mind with a deeper feeling of loneliness, than to tread the silent and deserted scene of former throng and pageant. On looking round on the vacant stalls of the knights and their esquires, and on the rows of dusty but gorgeous banners that were once borne before them, my imagination conjured up the scene when this hall was bright with the valour and beauty of the land; glittering with the splendour of jewelled rank and military array; alive with the tread of many feet and the hum of an admiring multitude. All had passed away; the silence of death had settled again upon the place, interrupted only by the casual chirping of birds, which had found their way into the chapel, and built their nests among its friezes and pendants—sure signs of solitariness and desertion.

When I read the names inscribed on the banners, they were those of men scattered far and wide about the world; some tossing upon distant seas; some under arms in distant lands; some mingling in the busy intrigues of courts and cabinets; all seeking to deserve one more distinction in this mansion of shadowy honours—the melancholy reward of a monument.

Two small aisles on each side of this chapel present a touching instance of the equality of the grave; which brings down the oppressor to a level with the oppressed, and mingles the dust of the bitterest enemies together. In one is the sepulchre of the haughty Elizabeth; in the other is that of her victim, the lovely and unfortunate Mary. Not an hour in the day but some ejaculation of pity is uttered over the fate of the latter, mingled with indignation at her oppressor. The walls of Elizabeth's sepulchre continually echo with the sighs of sympathy heaved at the grave of her rival.

A peculiar melancholy reigns over the aisle where Mary lies buried. The light struggles dimly through windows darkened by dust. The greater part of the place is in deep shadow, and the walls are stained

and tinted by time and weather. A marble figure of Mary is stretched upon the tomb, round which is an iron railing, much corroded, bearing her national emblem—the thistle. I was weary with wandering, and sat down to rest myself by the monument, revolving in my mind the checkered and disastrous story of poor Mary.

The sound of casual footsteps had ceased from the abbey. I could only hear, now and then, the distant voice of the priest repeating the evening service, and the faint responses of the choir; these paused for a time, and all was hushed. The stillness, the desertion and obscurity that were gradually prevailing around, gave a deeper and more solemn interest to the place:

> 'For in the silent grave no conversation,
> No joyful tread of friends, no voice of lovers,
> No careful father's counsel—nothing's heard,
> For nothing is, but all oblivion,
> Dust, and an endless darkness.'

Suddenly the notes of the deep-labouring organ burst upon the ear, falling with doubled and redoubled intensity, and rolling, as it were, huge billows of sound. How well do their volume and grandeur accord with this mighty building! With what pomp do they swell through its vast vaults, and breathe their awful harmony through these caves of death, and make the silent sepulchre vocal!—And now they rise in triumphant acclamation, heaving higher and higher their accordant notes, and piling sound on sound.—And now they pause, and the soft voices of the choir break out into sweet gushes of melody; they soar aloft, and warble along the roof, and seem to play about these lofty vaults like the pure airs of heaven. Again the pealing organ heaves its thrilling thunders, compressing air into music, and rolling it forth upon the soul. What long-drawn cadences! What solemn sweeping concords! It grows more and more dense and powerful—it fills the vast pile, and seems to jar the very walls—the ear is stunned—the senses are overwhelmed. And now it is winding up in full jubilee—it is rising from the earth to heaven—the very soul seems rapt away and floated upwards on this swelling tide of harmony!

Thomas Carlyle: 1795–

The Most Honourable.—From 'Sartor Resartus.'

Two men I honour, and no third. First, the toilworn craftsman that with earth-made implement laboriously conquers the earth, and makes her man's. Venerable to me is the hard hand; crooked, coarse; wherein notwithstanding lies a cunning virtue, indefeasibly royal, as of the sceptre of this planet. Venerable too is the rugged face, all weather-tanned,

besoiled, with its rude intelligence; for it is the face of a man living manlike. Oh, but the more venerable for thy rudeness, and even because we must pity as well as love thee! Hardly entreated brother! For us was thy back so bent, for us were thy straight limbs and fingers so deformed: thou wert our conscript, on whom the lot fell, and fighting our battles wert so marred. For in thee too lay a God-created form, but it was not to be unfolded; incrusted must it stand with the thick adhesions and defacements of labour; and thy body, like thy soul, was not to know freedom. Yet toil on, toil on; *thou* art in thy duty, be out of it who may; thou toilest for the altogether indispensable, for daily bread.

A second man I honour, and still more highly: him who is seen toiling for the spiritually indispensable; not daily bread, but the bread of life. Is not he too in his duty; endeavouring towards inward harmony; revealing this, by act or by word, through all his outward endeavours, be they high or low? Highest of all, when his outward and his inward endeavour are one: when we can name him artist; not earthly craftsman only, but inspired thinker, who with heaven-made implements conquers heaven for us! If the poor and humble toil that we have food, must not the high and glorious toil for him in return, that he have light, have guidance, freedom, immortality? These two, in all their degrees, I honour: all else is chaff and dust, which let the wind blow whither it listeth. Unspeakably touching is it, however, when I find both dignities united; and he that must toil outwardly for the lowest of man's wants, is also toiling inwardly for the highest. Sublimer in this world know I nothing than a peasant saint, could such now anywhere be met with. Such a one will take thee back to Nazareth itself; thou wilt see the splendour of heaven spring forth from the humblest depths of earth, like a light shining in great darkness.

Lord Macaulay: 1800–1859.

The Revolution of 1688–1689.—*From 'The History of England.'*

On the morning of Wednesday the 13th of February [1689] the court of Whitehall and all the neighbouring streets were filled with gazers. The magnificent Banqueting House, the masterpiece of Inigo, embellished by masterpieces of Rubens, had been prepared for a great ceremony. The walls were lined by the yeomen of the guard. Near the northern door, on the right hand, a large number of Peers had assembled. On the left were the Commons with their Speaker, attended by the mace. The southern door opened; and the Prince and Princess of Orange, side by side, entered, and took their place under the canopy of state.

Both Houses approached, bowing low. William and Mary advanced a few steps. Halifax on the right, and Powle on the left, stood forth; and Halifax spoke. The Convention, he said, had agreed to a resolution which he prayed Their Highnesses to hear. They signified their assent; and the clerk of the House of Lords read, in a loud voice, the Declaration of Right. When he had concluded, Halifax, in the name of all the Estates of the Realm, requested the Prince and Princess to accept the crown.

William, in his own name, and in that of his wife, answered that the crown was, in their estimation, the more valuable because it was presented to them as a token of the confidence of the nation. 'We thankfully accept,' he said, 'what you have offered us!' Then, for himself, he assured them that the laws of England, which he had once already vindicated, should be the rules of his conduct; that it should be his study to promote the welfare of the kingdom; and that, as to the means of doing so, he should constantly recur to the advice of the Houses, and should be disposed to trust their judgment rather than his own. These words were received with a shout of joy which was heard in the streets below, and was instantly answered by huzzas from many thousands of voices. The Lords and Commons then reverently retired from the Banqueting House, and went in procession to the great gate of Whitehall, where the heralds and pursuivants were waiting in their gorgeous tabards. All the space as far as Charing Cross was one sea of heads. The kettle-drums struck up; the trumpets pealed: and Garter King-at-arms, in a loud voice, proclaimed the Prince and Princess of Orange King and Queen of England, charged all Englishmen to pay, from that moment, faith and true allegiance to the new sovereigns, and besought God, who had already wrought so signal a deliverance for our church and nation, to bless William and Mary with a long and happy reign.

Thus was consummated the English Revolution. When we compare it with those revolutions which have during the last sixty years overthrown so many ancient governments, we cannot but be struck by its peculiar character. Why that character was so peculiar is sufficiently obvious, and yet seems not to have been always understood either by eulogists or by censors. The continental revolutions of the eighteenth and nineteenth centuries took place in countries where all trace of the limited monarchy of the middle ages had long been effaced. The right of the prince to make laws and to levy money had, during many generations, been undisputed. His throne was guarded by a great regular army. His administration could not, without extreme peril, be blamed even in the mildest terms. His subjects held their personal liberty by no other tenure than his pleasure. Not a single institution was left which had, within the memory of the oldest man, afforded efficient protection to the subject

against the utmost excess of tyranny. Those great councils which had once curbed the regal power had sunk into oblivion. Their composition and their privileges were known only to antiquaries. We cannot wonder, therefore, that, when men who had been thus ruled succeeded in wresting supreme power from a government which they had long in secret hated, they should have been impatient to demolish and unable to construct; that they should have been fascinated by every specious novelty; that they should have proscribed every title, ceremony, and phrase associated with the old system; and that, turning away with disgust from their own national precedents and traditions, they should have sought for principles of government in the writings of theorists, or aped, with ignorant and ungraceful affectation, the patriots of Athens and Rome. As little can we wonder that the violent action of the revolutionary spirit should have been followed by reaction equally violent, and that confusion should speedily have engendered despotism sterner than that from which it had sprung.

Had we been in the same situation; had Strafford succeeded in his favourite scheme of Thorough; had he formed an army as numerous and as well disciplined as that which, a few years later, was formed by Cromwell; had a series of judicial decisions similar to that which was pronounced by the Exchequer Chamber in the case of ship-money, transferred to the crown the right of taxing the people; had the Star Chamber and the High Commission continued to fine, mutilate, and imprison every man who dared to raise his voice against the government; had the press been as completely enslaved here as at Vienna or Naples; had our kings gradually drawn to themselves the whole legislative power; had six generations of Englishmen passed away without a single session of Parliament; and had we then at length risen up in some moment of wild excitement against our masters, what an outbreak would that have been! With what a crash, heard and felt to the furthest ends of the world, would the whole vast fabric of society have fallen! How many thousands of exiles, once the most prosperous and the most refined members of this great community, would have begged their bread in continental cities, or have sheltered their heads under huts of bark in the uncleared forests of America! How often should we have seen the pavement of London piled up in barricades, the houses dinted with bullets, the gutters foaming with blood! How many times should we have rushed wildly from extreme to extreme, sought refuge from anarchy in despotism, and been again driven by despotism into anarchy! How many years of blood and confusion would it have cost us to learn the very rudiments of political science! How many childish theories would have duped us! How many rude and ill-poised constitutions should we have set up, only to see them tumble down! Happy would it have been for us if a sharp discipline of

half a century had sufficed to educate us into a capacity of enjoying true freedom.

These calamities our Revolution averted. It was a revolution strictly defensive, and had prescription and legitimacy on its side. Here, and here only, a limited monarchy of the thirteenth century had come down unimpaired to the seventeenth century. Our parliamentary institutions were in full vigour. The main principles of our government were excellent. They were not, indeed, formally and exactly set forth in a single written instrument; but they were to be found scattered over our ancient and noble statutes; and, what was of far greater moment, they had been engraven on the hearts of Englishmen during four hundred years. That, without the consent of the representatives of the nation, no legislative act could be passed, no tax imposed, no regular soldiery kept up; that no man could be imprisoned, even for a day, by the arbitrary will of the sovereign; that no tool of power could plead the royal command as a justification for violating any right of the humblest subject, were held, both by Whigs and Tories, to be fundamental laws of the realm. A realm of which these were the fundamental laws stood in no need of a new constitution.

But though a new constitution was not needed, it was plain that changes were required. The misgovernment of the Stuarts, and the troubles which that misgovernment had produced, sufficiently proved that there was somewhere a defect in our polity; and that defect it was the duty of the Convention to discover and to supply. . . . . The Convention had two great duties to perform. The first was, to clear the fundamental laws of the realm from ambiguity. The second was, to eradicate from the minds, both of the governors and the governed, the false and pernicious notion that the royal prerogative was something more sublime and holy than those fundamental laws. The former object was attained by the solemn recital and claim with which the Declaration of Right commences; the latter, by the resolution which pronounced the throne vacant, and invited William and Mary to fill it. . . . .

The highest eulogy which can be pronounced on the Revolution of 1688 is this, that it was our last revolution. Several generations have now passed away since any wise and patriotic Englishman has meditated resistance to the established government. In all honest and reflecting minds there is a conviction, daily strengthened by experience, that the means of effecting every improvement which the constitution requires may be found within the constitution itself.

Lord Lytton: 1805—

Uncle Jack.—From 'The Caxtons.'

You never saw a more charming man than Uncle Jack. All plump people are more popular than thin people. There is something jovial and pleasant in the sight of a round face! What conspiracy could succeed when its head was a lean and hungry-looking fellow, like Cassius? If the Roman patriots had had Uncle Jack amongst them, perhaps they would never have furnished a tragedy to Shakspeare. Uncle Jack was as plump as a partridge—not unwieldy, not corpulent, not obese, not '*vastus*,' which Cicero objects to in an orator—but every crevice comfortably filled up. Like the ocean, 'time wrote no wrinkles on his glassy (or brassy) brow.' His natural lines were all upward curves, his smile most ingratiating, his eye so frank, even his trick of rubbing his clean, well-fed, English-looking hands had something about it coaxing and *débonnair*, something that actually decoyed you into trusting your money into hands so prepossessing. Indeed, to him might be fully applied the expression: 'He had his soul's seat in his finger-ends.' The critics observe that few men have ever united in equal perfection the imaginative with the scientific faculties. 'Happy he,' exclaims Schiller, 'who combines the enthusiast's warmth with the worldly man's light'—light and warmth, Uncle Jack had them both. He was a perfect symphony of bewitching enthusiasm and convincing calculation. Dicæopolis in the *Acharnenses*, in presenting a gentleman called Nicharchus to the audience, observes: 'He is small, I confess, but there is nothing lost in him; all is knave that is not fool.' Parodying the equivocal compliment, I may say that though Uncle Jack was no giant, there was nothing lost in him. Whatever was not philanthropy was arithmetic, and whatever was not arithmetic was philanthropy. He would have been equally dear to Howard and to Cocker. Uncle Jack was comely too—clear-skinned and florid, had a little mouth, with good teeth, wore no whiskers, shaved his beard as close as if it were one of his grand national companies; his hair, once somewhat sandy, was now rather grayish, which increased the respectability of his appearance; and he wore it flat at the sides and raised in a peak at the top; his organs of constructiveness and ideality were pronounced by Mr Squills to be prodigious, and those freely developed bumps gave great breadth to his forehead. Well-shaped, too, was Uncle Jack, about five feet eight, the proper height for an active man of business. He wore a black coat; but to make the nap look the fresher, he had given it the relief of gilt buttons, on which were wrought a small crown and anchor; at a distance this button looked like the king's button, and gave him the air of one who has a place about court. He always wore a white neckcloth without starch, a frill, and

a diamond pin, which last furnished him with observations upon certain mines of Mexico, which he had a great, but hitherto unsatisfied desire of seeing worked by a grand National United Britons Company. His waistcoat of a morning was pale buff—of an evening, embroidered velvet; wherewith were connected sundry schemes of an 'association for the improvement of native manufactures.' His trousers, matutinally, were of the colour vulgarly called 'blotting-paper;' and he never wore boots, which, he said, unfitted a man for exercise, but short drab gaiters and square-toed shoes. His watch-chain was garnished with a vast number of seals: each seal, indeed, represented the device of some defunct company, and they might be said to resemble the scalps of the slain, worn by the aboriginal Iroquois—concerning whom, indeed, he had once entertained philanthropic designs, compounded of conversion to Christianity on the principles of the English Episcopal Church, and of an advantageous exchange of beaver-skins for Bibles, brandy, and gunpowder. . . . .

We took long walks together, and in the midst of his most diverting conversation my uncle was always an observer. He would stop to examine the nature of the soil, fill my pockets (not his own) with great lumps of clay, stones, and rubbish, to analyse when he got home, by the help of some chemical apparatus he had borrowed from Mr Squills. He would stand an hour at a cottage door, admiring the little girls who were straw-plaiting, and then walk into the nearest farm-houses, to suggest the feasibility of 'a national straw-plait association.' All this fertility of intellect was, alas! wasted in that *ingrata terra*[1] into which Uncle Jack had fallen. No squire could be persuaded into the belief that his mother-stone was pregnant with minerals; no farmer talked into weaving straw-plait into a proprietary association. So, even as an ogre, having devastated the surrounding country, begins to cast a hungry eye on his own little ones, Uncle Jack's mouth, long defrauded of juicier and more legitimate morsels, began to water for a bite of my innocent father.

William Makepeace Thackeray: 1811—1863.

The Last Days of Colonel Newcome.—From 'The Newcomes.'

Clive, and the boy sometimes with him, used to go daily to Grey Friars, where the Colonel still lay ill. After some days, the fever, which had attacked him, left him; but left him so weak and enfeebled that he could only go from his bed to the chair by his fireside. The season was exceedingly bitter, the chamber which he inhabited was warm and spacious; it was considered unadvisable to move him until he had attained greater strength, and till warmer weather. The medical men of the House hoped

[1] Latin, 'ungrateful land.'

he might rally in spring. My friend, Dr Goodenough, came to him; he hoped too: but not with a hopeful face. A chamber, luckily vacant, hard by the Colonel's was assigned to his friend's, where we sat when we were too many for him. Besides his customary attendant, he had two dear and watchful nurses, who were almost always with him—Ethel and Madame de Florac, who had passed many a faithful year by an old man's bedside; who would have come, as to a work of religion, to any sick couch, much more to this one, where he lay for whose life she would once gladly have given her own.

But our Colonel, we all were obliged to acknowledge, was no more our friend of old days. He knew us again, and was good to every one round him, as his wont was; especially when Boy came, his old eyes lighted up with simple happiness, and, with eager trembling hands, he would seek under his bedclothes, or the pockets of his dressing-gown, for toys or cakes, which he had caused to be purchased for his grandson. There was a little, laughing, red-cheeked, white-headed gown-boy of the school, to whom the old man had taken a great fancy. One of the symptoms of his returning consciousness and recovery, as we hoped, was his calling for this child, who pleased our friend by his archness and merry ways; and who, to the old gentleman's unfailing delight, used to call him 'Codd Colonel.' 'Tell little F—— that Codd Colonel wants to see him!' and the little gown-boy was brought to him; and the Colonel would listen to him for hours, and hear all about his lessons and his play; and prattle, almost as childishly, about Dr Raine, and his own early school-days. The boys of the school, it must be said, had heard the noble old gentleman's touching history, and had all got to know and love him. They came every day to hear news of him; sent him in books and papers to amuse him; and some benevolent young souls—God's blessing on all honest boys, say I—painted theatrical characters, and sent them in to Codd Colonel's grandson. The little fellow was made free of gown-boys, and once came thence to his grandfather in a little gown, which delighted the old man hugely. Boy said he would like to be a little gown-boy; and I make no doubt, when he is old enough, his father will get him that post, and put him under the tuition of my friend Dr Senior.

So weeks passed away, during which our dear old friend still remained with us. His mind was gone at intervals, but would rally feebly; and with his consciousness returned his love, his simplicity, his sweetness. He would talk French with Madame de Florac, at which time his memory appeared to awaken with surprising vividness, his cheek flushed, and he was a youth again—a youth all love and hope—a stricken old man, with a beard as white as snow covering the noble careworn face. At such times he called her by her Christian name of Léonore; he addressed courtly old words of regard and kindness to the aged lady; anon he wandered in his

talk, and spoke to her as if they still were young. Now, as in those early days, his heart was pure; no anger remained in it; no guile tainted it; only peace and good-will dwelt in it.

The days went on, and our hopes, raised sometimes, began to flicker and fail. One evening the Colonel left his chair for his bed in pretty good spirits, but passed a disturbed night, and the next morning was too weak to rise. Then he remained in his bed, and his friends visited him there. One afternoon he asked for his little gown-boy, and the child was brought to him, and sat by the bed with a very awe-stricken face; and then gathered courage, and tried to amuse him by telling him how it was a half-holiday, and they were having a cricket-match with the St Peter's boys in the green, and Grey Friars was in and winning. The Colonel quite understood about it; he would like to see the game; he had played many a game on that green when he was a boy. He grew excited; Clive dismissed his father's little friend, and put a sovereign into his hand; and away he ran to say that Codd Colonel had come into a fortune, and to buy tarts, and to see the match out. *I, curre*,[1] little white-haired gown-boy! Heaven speed you, little friend.

After the child had gone, Thomas Newcome began to wander more and more. He talked louder; he gave the word of command, spoke Hindostanee as if to his men. Then he spoke words in French rapidly, seizing a hand that was near him, and crying: 'Toujours, toujours!'[2] But it was Ethel's hand which he took. Ethel and Clive and the nurse were in the room with him; the latter came to us who were sitting in the adjoining apartment; Madame de Florac was there, with my wife and Bayham.

At the look in the woman's countenance, Madame de Florac started up. 'He is very bad, he wanders a great deal,' the nurse whispered. The French lady fell instantly on her knees, and remained rigid in prayer.

Some time afterwards, Ethel came in with a scared face to our pale group. 'He is calling for you again, dear lady,' she said, going up to Madame de Florac, who was still kneeling; 'and just now he said he wanted Pendennis to take care of his boy. He will not know you.' She hid her tears as she spoke.

She went into the room, where Clive was at the bed's foot; the old man within it talked on rapidly for a while: then again he would sigh and be still: once more I heard him say hurriedly: 'Take care of him when I'm in India;' and then with a heart-rending voice he called out: 'Léonore, Léonore!' She was kneeling by his side now. The patient's voice sank into faint murmurs; only a moan now and then announced that he was not asleep.

At the usual evening hour the chapel bell began to toll, and Thomas

[1] Go, run. [2] Always, always.

Newcome's hands outside the bed feebly beat a time. And just as the last bell struck, a peculiar sweet smile shone over his face, and he lifted up his head a little, and quickly said 'Adsum!'[1] and fell back. It was the word we used at school, when names were called; and lo, he, whose heart was as that of a little child, had answered to his name, and stood in the presence of The Master.

Charles Dickens: 1812—

Death of Paul Dombey.—From 'Dombey and Son.'

Paul had never risen from his little bed. He lay there, listening to the noises in the street, quite tranquilly; not caring much how the time went, but watching it and watching everything about him with observing eyes.

When the sunbeams struck into his room through the rustling blinds, and quivered on the opposite wall like golden water, he knew that evening was coming on, and that the sky was red and beautiful. As the reflection died away, and a gloom went creeping up the wall, he watched it deepen, deepen, deepen into night. Then he thought how the long streets were dotted with lamps, and how the peaceful stars were shining overhead. His fancy had a strange tendency to wander to the river, which he knew was flowing through the great city: and now he thought how black it was, and how deep it would look, reflecting the hosts of stars—and more than all, how steadily it rolled away to meet the sea.

As it grew later in the night, and footsteps in the street became so rare that he could hear them coming, count them as they paused, and lose them in the hollow distance, he would lie and watch the many-coloured ring about the candle, and wait patiently for day. His only trouble was, the swift and rapid river. He felt forced, sometimes, to try to stop it—to stem it with his childish hands—or choke its way with sand—and when he saw it coming on, resistless, he cried out! But a word from Florence, who was always at his side, restored him to himself; and leaning his poor head upon her breast, he told Floy of his dream, and smiled.

When day began to dawn again, he watched for the sun; and when its cheerful light began to sparkle in the room, he pictured to himself—pictured! he saw—the high church towers rising up into the morning sky, the town reviving, waking, starting into life once more, the river, glistening as it rolled (but rolling fast as ever), and the country bright with dew. Familiar sounds and cries came by degrees into the street below; the servants in the house were roused and busy; faces looked in at the door, and voices asked his attendants softly how he was. Paul always answered

[1] I am present.

for himself: 'I am better. I am a great deal better, thank you! Tell papa so!'

By little and little, he got tired of the bustle of the day, the noise of carriages and carts, and people passing and repassing; and would fall asleep, or be troubled with a restless and uneasy sense again—the child could hardly tell whether this were in his sleeping or his waking moments—of that rushing river. 'Why, will it never stop, Floy?' he would sometimes ask her. 'It is bearing me away, I think!'

But Floy could always soothe and reassure him; and it was his daily delight to make her lay her head down on his pillow, and take some rest.

'You are always watching me, Floy. Let me watch *you*, now!' They would prop him up with cushions in a corner of his bed, and there he would recline the while she lay beside him: bending forward oftentimes to kiss her, and whispering to those who were near that she was tired, and how she had sat up so many nights beside him.

Thus the flush of the day, in its heat and light, would gradually decline; and again the golden water would be dancing on the wall.

He was visited by as many as three grave doctors—they used to assemble down-stairs, and come up together—and the room was so quiet, and Paul was so observant of them (though he never asked of anybody what they said), that he even knew the difference in the sound of their watches. But his interest centered in Sir Parker Peps, who always took his seat on the side of the bed. For Paul had heard them say long ago, that that gentleman had been with his mamma when she clasped Florence in her arms, and died. And he could not forget it, now. He liked him for it. He was not afraid.

The people round him changed as unaccountably as on that first night at Doctor Blimber's—except Florence; Florence never changed—and what had been Sir Parker Peps, was now his father, sitting with his head upon his hand. Old Mrs Pipchin dozing in an easy chair, often changed to Miss Tox, or his aunt; and Paul was quite content to shut his eyes again, and see what happened next without emotion. But this figure with its head upon its hand returned so often, and remained so long, and sat so still and solemn, never speaking, never being spoken to, and rarely lifting up its face, that Paul began to wonder languidly, if it were real; and in the night-time saw it sitting there, with fear.

'Floy!' he said, 'what *is* that?'

'Where, dearest?'

'There! at the bottom of the bed.'

'There's nothing there, except papa!'

The figure lifted up its head, and rose, and coming to the bedside, said: 'My own boy! Don't you know me?'

Paul looked it in the face, and thought, was this his father? But the face, so altered to his thinking, thrilled while he gazed, as if it were in pain; and before he could reach out both his hands to take it between them, and draw it towards him, the figure turned away quickly from the little bed, and went out at the door.

Paul looked at Florence with a fluttering heart, but he knew what she was going to say, and stopped her with his face against her lips. The next time he observed the figure sitting at the bottom of the bed, he called to it: 'Don't be so sorry for me, dear papa! Indeed I am quite happy!'

His father coming, and bending down to him—which he did quickly, and without first pausing by the bedside—Paul held him round the neck, and repeated those words to him several times, and very earnestly; and Paul never saw him in his room again at any time, whether it were day or night, but he called out: 'Don't be so sorry for me! Indeed I am quite happy!' This was the beginning of his always saying in the morning that he was a great deal better, and that they were to tell his father so.

How many times the golden water danced upon the wall; how many nights the dark, dark river rolled towards the sea in spite of him; Paul never counted, never sought to know. If their kindness or his sense of it, could have increased, they were more kind, and he more grateful every day; but whether they were many days or few, appeared of little moment now to the gentle boy.

One night he had been thinking of his mother, and her picture in the drawing-room down-stairs, and had thought she must have loved sweet Florence better than his father did, to have held her in her arms when she felt that she was dying—for even he, her brother, who had such dear love for her, could have no greater wish than that. The train of thought suggested to him to inquire if he had ever seen his mother? for he could not remember whether they had told him yes or no, the river running very fast, and confusing his mind.

'Floy, did I ever see mamma?'

'No, darling. Why?'

'Did I never see any kind face, like mamma's, looking at me when I was a baby, Floy?'

He asked, incredulously, as if he had some vision of a face before him.

'O yes, dear!'

'Whose, Floy?'

'Your old nurse's. Often.'

'And where is my old nurse?' said Paul. 'Is she dead too? Floy, are we *all* dead, except you?'

There was a hurry in the room for an instant—longer, perhaps; but

it seemed no more—then all was still again; and Florence, with her face quite colourless, but smiling, held his head upon her arm. Her arm trembled very much.

'Shew me that old nurse, Floy, if you please!'

'She is not here, darling. She shall come to-morrow.'

'Thank you, Floy!'

Paul closed his eyes with those words, and fell asleep. When he awoke the sun was high, and the broad day was clear and warm. He lay a little, looking at the windows, which were open, and the curtains rustling in the air, and waving to and fro—then he said: 'Floy, is it to-morrow? Is she come?'

Some one seemed to go in quest of her. Perhaps it was Susan. Paul thought he heard her telling him, when he had closed his eyes again, that she would soon be back; but he did not open them to see. She kept her word—perhaps she had never been away—but the next thing that happened was a noise of footsteps on the stairs, and then Paul woke—woke mind and body—and sat upright in his bed. He saw them now about him. There was no gray mist before them, as there had been sometimes in the night. He knew them every one, and called them by their names.

'And who is this? Is this my old nurse?' said the child, regarding with a radiant smile a figure coming in.

Yes, yes. No other stranger would have shed those tears at sight of him, and called him her dear boy, her pretty boy, her own poor blighted child. No other woman would have stooped down by his bed, and taken up his wasted hand, and put it to her lips and breast, as one who had some right to fondle it. No other woman would have so forgotten everybody there but him and Floy, and been so full of tenderness and pity.

'Floy! this is a kind good face!' said Paul. 'I am glad to see it again. Don't go away, old nurse! Stay here!'

His senses were all quickened, and he heard a name he knew.

'Who was that who said "Walter?"' he asked, looking round. 'Some one said Walter. Is he here? I should like to see him very much.'

Nobody replied directly; but his father soon said to Susan: 'Call him back, then: let him come up!' After a short pause of expectation, during which he looked with smiling interest and wonder on his nurse, and saw that she had not forgotten Floy, Walter was brought into the room. His open face and manner, and his cheerful eyes, had always made him a favourite with Paul; and when Paul saw him, he stretched out his hand, and said: 'Good-bye!'

'Good-bye, my child!' cried Mrs Pipchin, hurrying to his bed's head. 'Not good-bye?'

For an instant Paul looked at her with the wistful face with which he

had so often gazed upon her in his corner by the fire. 'Ah, yes,' he said, placidly, 'good-bye! Walter, dear, good-bye!'—turning his head to where he stood, and putting out his hand again. 'Where is papa?'

He felt his father's breath upon his cheek, before the words had parted from his lips.

'Remember Walter, dear papa,' he whispered, looking in his face. 'Remember Walter. I was fond of Walter!' The feeble hand waved in the air, as if it cried 'Good-bye!' to Walter once again.

'Now lay me down,' he said; 'and Floy, come close to me, and let me see you!'

Sister and brother wound their arms around each other, and the golden light came streaming in, and fell upon them, locked together.

'How fast the river runs, between its green banks and the rushes, Floy! But it's very near the sea. I hear the waves! They always said so!'

Presently he told her that the motion of the boat upon the stream was lulling him to rest. How green the banks were now, how bright the flowers growing on them, and how tall the rushes! Now the boat was out at sea, but gliding smoothly on. And now there was a shore before him. Who stood on the bank!—

He put his hands together, as he had been used to do at his prayers. He did not remove his arms to do it; but they saw him fold them so, behind her neck.

'Mamma is like you, Floy. I know her by the face! But tell them that the print upon the stairs at school is not divine enough. The light about the head is shining on me as I go!'

The golden ripple on the wall came back again, and nothing else stirred in the room. The old, old fashion! The fashion that came in with our first garments, and will last unchanged until our race has run its course, and the wide firmament is rolled up like a scroll. The old, old fashion—Death!

Oh, thank God, all who see it, for that older fashion yet, of Immortality! And look upon us, angels of young children, with regards not quite estranged, when the swift river bears us to the ocean!

ALPHABETICAL INDEX OF AUTHORS.

Addison, Joseph (1672—1719), one of the most elegant of our prose-writers—gained a high reputation by his poems, among which are *The Campaign* of the Duke of Marlborough, and the tragedy of *Cato*. His fame rests chiefly on his contributions to *The Tatler*, *Spectator*, and *Guardian*—he was principal Secretary of State in 1717, pp. 202, 267.

Bacon, Francis (1561—1626), Lord High Chancellor of England—the greatest of English prose-writers. Of his works his *Essays* are those most generally read, p. 252.

Barnfield, Richard (born about 1570), is known chiefly from the circumstance that some of his pieces were ascribed to Shakspeare, p. 179.

Barrow, Isaac (1630—1677), Vice-chancellor of Cambridge University—in mathematics considered second only to Sir Isaac Newton, but better known by his theological works, p. 260.

Beattie, James (1735—1803), author of the poem called *The Minstrel*, was Professor of Moral Philosophy in Marischal College, Aberdeen, p. 214.

Beaumont and Fletcher (Francis Beaumont, 1586—1615; John Fletcher, 1576—1625), two gentlemen of good birth and education, wrote in company fifty-two dramatic compositions—they share with Ben Jonson the second rank in English dramatic literature, p. 190.

Bryant, William Cullen (1794—), a newspaper editor—one of the most popular of the American poets—Chief works: *Thanatopsis*, or Thoughts on Death, and *The Ages*, a survey of the experience of mankind, p. 245.

Burke, Edmund (1730—1797), the greatest of English orators—celebrated for his *Inquiry into the Origin of our Ideas of the Sublime and Beautiful*, his Speeches in the House of Commons, and his *Reflections on the Revolution in France*, p. 292.

Burns, Robert (1759—1796), the great lyric poet of Scotland—the son of a small farmer in Ayrshire—Chief poems: *Halloween*, *The Cotter's Saturday Night*, *The Jolly Beggars*, *The Two Dogs*, *Tam o' Shanter*, and an unequalled collection of songs, p. 218.

Butler, Samuel (1612—1680), a native of Worcestershire—author of *Hudibras*, a burlesque to ridicule the Puritans, p. 198.

Byron, Lord (1788—1824), a celebrated poet—Chief poems: *Hours of Idleness*; *English Bards and Scotch Reviewers*; *Childe Harold*, one of the greatest poems of the century; *The Giaour* and other Eastern tales; *The Prisoner of Chillon*; *Manfred*, a dramatic poem; *Beppo*, a tale of Italian life; and *Don Juan*. He died at Missolonghi in Greece, whither he had gone to aid in the struggle of Greece for independence, p. 237.

Campbell, Thomas (1777—1844), a native of Glasgow—celebrated for his *Pleasures of Hope*, a sentimental poem; *Gertrude of Wyoming*, a Pennsylvanian tale; *Theodoric*, a Swiss story; and a number of noble lyrics, p. 230.

Carew, Thomas (1589—1639), a gentleman at the court of Charles I., wrote a number of short poems and a masque, p. 191.

Carlyle, Thomas (1795—), a native of Dumfriesshire—one of the most distinguished living authors—Chief works: *Life of Schiller*, *Sartor Resartus* (The Tailor Done Over), *History of the French Revolution*, *Cromwell's Letters and Speeches*, *History of Frederick the Great*, and *Life of John Sterling*, p. 307.

Clarendon, Lord. See **Hyde.**

Coleridge, Samuel Taylor (1772—1834), born in Devonshire—the most original of modern poets—Chief poems: *Genevieve*, *The Ancient Mariner*, *Christabel*, and *Odes*, pp. 225, 300.

Collins, William (1721—1759), a native of Chichester—famous for his *Odes*, which are among the best in the language, p. 208.

Cowley, Abraham (1618—1667), son of a London stationer—perhaps the most popular poet of his time—his prose works consist of *Essays*, chiefly philosophical, pp. 197, 256.

Cowper, William (1731—1800), the most popular poet of his day—Chief poems: *The Task*, *Table Talk*, *Truth*, *The Progress of Error*, and the famous ballad, *John Gilpin*, p. 215.

Crabbe, George (1754—1832), a clergyman in Suffolk—Chief poems: *The Village, The Parish Register, The Borough, Tales in Verse*, and *Tales of the Hall*, p. 219.

De Foe, Daniel (1661—1731), a London tradesman, commenced *The Review*, the first English periodical—he is celebrated chiefly for his *Robinson Crusoe, The History of the Great Plague*, and other fictions, p. 264.

Dickens, Charles (1812—), a native of Landport, Portsmouth—the most popular living novelist—began life as a parliamentary reporter—Chief works: *Pickwick Papers, Nicholas Nickleby, The Old Curiosity Shop, Barnaby Rudge, David Copperfield, Martin Chuzzlewit, Dombey and Son, Bleak House, Hard Times, Little Dorrit, A Tale of Two Cities, Great Expectations, Our Mutual Friend*, and his *Christmas Tales*, p. 316.

Drayton, Michael (1563—1631), is known chiefly by his *Polyolbion*, a poetical description of England in thirty books, and the fairy ballad *Nymphidia*, p. 179.

Drummond, William (1585—1649), of Hawthornden, near Edinburgh—celebrated for his sonnets, which are considered among the finest in the language, p. 191.

Dryden, John (1631—1700), son of a gentleman in Worcestershire—one of the greatest of English poets—ranked among the best writers of prose—and the most celebrated dramatist of his day—Chief poems: *Annus Mirabilis* (The Year of Wonders, 1666): *Absalom and Achitophel*, the finest political satire in the language; *Religio Laici* (The Layman's Religion), a defence of the English Church; *The Hind and the Panther*, an allegory personifying the Roman and English Churches; *Alexander's Feast*; and *Fables*. His prose works are essays, prefaces, &c., pp. 199, 261.

Fielding, Henry (1707—1754), the greatest of English novelists—Chief works: *Joseph Andrews, A Journey from this World to the Next, Jonathan Wild*, and *Tom Jones*, p. 274.

Gay, John (1688—1732), a native of Devonshire—wrote several plays, the most successful of which was *The Beggars' Opera*, still a favourite. His most popular poems are his *Fables*, and the song, *Black-eyed Susan*, p. 202.

Gibbon, Edward (1737—1794), the son of a gentleman of family and fortune—is celebrated for his *History of the Decline and Fall of the Roman Empire*, p. 290.

Goldsmith, Oliver (1728—1774), the son of an Irish curate—equally distinguished as a poet and prose-writer—Chief poems: *The Traveller* and *The Deserted Village*. Chief prose works: *The Citizen of the World, The Vicar of Wakefield*, the comedies of *The Good-natured Man* and *She Stoops to Conquer*; *Histories of England, France, and Greece*; and *History of Animated Nature*, pp. 211, 289.

Gray, Thomas (1716—1771), son of a London scrivener—celebrated for his splendid odes, *The Progress of Poesy* and *The Bard*, and his *Elegy in a Country Churchyard*, p. 210.

Hall, Rev. Robert (1764—1831), a Baptist minister—one of the most famous preachers of his time in England. His most celebrated writings are: *An Apology for the Freedom of the Press*, and his *Sermons*, p. 295.

Herbert, George (1593—1632), an English clergyman of noble birth—distinguished for his sacred poems called *The Temple*, p. 197.

Herrick, Robert (1591—1674), an English clergyman—one of the most exquisite of our early lyrical poets, p. 190.

Hooker, Richard (1553—1600), a clergyman of the Church of England, wrote a defence of the Church against the Puritans, entitled *The Laws of Ecclesiastical Polity*, which is one of the greatest works in the language, p. 251.

Hume, David (1711—1776), son of a Scottish country gentleman—author of several philosophical works—famous for his *History of England*, the first example in English of the highest kind of historical composition, p. 278.

Hunt, Leigh (1784—1859), joint editor and proprietor of *The Examiner*, a London newspaper, among other poems wrote *The Feast of the Poets*; *Rimini*, a tale of early Italian life; *A Legend of Florence*; *The Palfrey*; and various essays in prose, p. 244.

Hyde, Edward, Earl of Clarendon (1608—1674), Lord Chancellor of England, is famous for his *History of the Rebellion*, p. 257.

Irving, Washington (1783—1859), a distinguished American author—Chief works: *The Sketch Book*, a series of exquisite tales and essays; *Bracebridge Hall*, a description of old English manners; *Tales of a Traveller*; *Life of Columbus*; *The Conquest of Granada*; *Mahomet and his Successors*; and a *Life of Washington*, p. 305.

Jeffrey, Francis (1773—1850), an Edinburgh advocate, and afterwards judge, was the most celebrated critic and essayist of his time. His essays were contributed to *The Edinburgh Review*, of which he was editor, p. 303.

Johnson, Samuel (1709—1784), son of a bookseller at Lichfield—best known by his *Dictionary of the English Language*, which occupied him for eight years. He also issued two periodicals, *The Rambler* and *The Idler*; *Rasselas*, an Eastern tale; *The Lives of the Poets*, his best prose composition; and several poems, the best of which is *The Vanity of Human Wishes*, p. 276.

Jonson, Ben (1573—1637), a London actor, wrote several plays both tragic and comic, which are now little read. The chief of these are the tragedies of *Sejanus* and *Catiline*. He also perfected the compositions called *Masques*, which formed a favourite amusement of the court, p. 188.

Keats, John (1796—1821), educated as a surgeon's apprentice—one of the greatest of young poets—Chief poems: *Endymion*, *Hyperion*, and *The Eve of St Agnes*, p. 244.

Lamb, Charles (1775—1834), a poet and essayist, was a clerk in the India House. His fame rests chiefly on his *Essays by Elia*, p. 301.

Locke, John (1632—1704), the greatest philosophical writer of his time.—Chief work: *An Essay on the Human Understanding*, p. 262.

Longfellow, Henry Wadsworth (1807—), Professor of Modern Languages in Harvard University, Cambridge, U.S.—is one of the most popular of American poets — Chief poems: *Voices of the Night*, *Evangeline*, *Golden Legend*, *Hiawatha*, *Courtship of Miles Standish*, and *Tales of a Wayside Inn*, p. 248.

Lytton, Lord (1805—), a distinguished politician and novelist. Of his numerous works the most important are *Eugene Aram*, *The Last Days of Pompeii*, *Rienzi*, *The Caxtons*, *My Novel*, and *What will he do with it?* His *Lady of Lyons* and *Richelieu* are among the most popular of English plays, p. 312.

Macaulay, Lord (1800—1859), the most famous historian of his time—celebrated for his unfinished *History of England from the Accession of James II.*; his unequalled *Essays*, contributed to *The Edinburgh Review*; and his *Lays of Ancient Rome*, pp. 246, 308.

Marlowe, Christopher (1562—1593), the greatest of Shakspeare's precursors in the drama—Chief plays: *Doctor Faustus* and *Edward II.*, p. 179.

Milton, John (1608—1674), among English poets next to Shakspeare. He was Latin secretary to Oliver Cromwell, and for the last 22 years of his life was totally blind.—Chief poems: *Paradise Lost*, *Paradise Regained*, *Samson Agonistes*, *Lycidas*, and *Comus*. Chief prose works: *History of England to the Norman Conquest*, a *Tractate on Education*, and *Areopagitica*, one of the noblest pieces of eloquence in the language, pp. 192, 254.

Montgomery, James (1771—1854), born at Irvine in Ayrshire, was the most popular writer of religious poetry in the period, p. 241.

Moore, Thomas (1780—1852), a native of Dublin—chiefly popular on account of his *Lalla Rookh*, a brilliant series of oriental tales, and his *Songs* and *Irish Melodies*, p. 282.

Pope, Alexander (1688—1744), the greatest poet of his time—Chief poems: *Essay on Criticism*, *The Rape of the Lock*, *The Dunciad*, *Essay on Man*, and translations of Homer's *Iliad* and *Odyssey*, p. 203.

Prior, Matthew (1664—1721), occupied in succession several important state positions—best known by his tales and light verses, p. 202.

Raleigh, Sir Walter (1552—1618), a good soldier, and the leader of several important nautical expeditions, was unjustly confined in the Tower of London for 14 years, during which he wrote his famous *History of the World*. He was afterwards beheaded, p. 179.

Robertson, Dr William (1721—1793), a Scottish clergyman, Principal of the University of Edinburgh, ranks with Hume and Gibbon among the greatest of English historians. His works are: *History of Scotland during the Reigns of Queen Mary and King James VI.*, *History of the Reign of the Emperor Charles V.*, and *History of America*, p. 284.

Rogers, Samuel (1763—1855), a London banker, wrote several elaborately finished poems, the chief of which are *The Pleasures of Memory*, *The Voyage of Columbus*, *Human Life*, and *Italy*, p. 220.

Scott, Sir Walter (1771—1832), Sheriff-depute of Selkirkshire, one of the greatest of English poets and novelists—Chief poems: *Lay of the Last Minstrel*, *Lady of the Lake*, *Vision of Don Roderick*, *Rokeby*, and *Lord of the*

Isles. Of his numerous prose works the principal are the *Waverley Novels*, *Lives of the Novelists*, *of Dryden*, *of Swift*, and of *Napoleon*, and *The Tales of a Grandfather*, pp. 232, 298.

Shakspeare, William (1564—1616), the greatest name in our literature, was born at Stratford-on-Avon. He became a player in London, and afterwards the manager of a theatre. His works consist of thirty-seven plays, two poems, and a collection of sonnets, p. 180.

Shelley, Percy Bysshe (1792—1822), the son of a Sussex baronet—Chief poems: *Queen Mab*, written at the age of sixteen; *Alastor, or the Spirit of Solitude*; *The Revolt of Islam*; *Prometheus Unbound*, a classic drama; *The Cenci*, a tragedy; and his odes to *The Cloud* and to *The Skylark*, p. 242.

Shenstone, William (1714—1763), a native of Shropshire, is known chiefly by his poems *The Schoolmistress*, and the *Pastoral Ballad*, and his *Essays*, p. 209.

Smith, Rev. Sydney (1768—1845), an English clergyman—one of the wittiest and most popular writers of his time. In conjunction with Jeffrey, Murray, and Brougham, he started *The Edinburgh Review*—Chief works: *Contributions to the Review*, *Peter Plymley's Letters on the Catholics*, and *Sermons*, p. 296.

Smollett, Tobias George (1721—1771), a native of Dumbartonshire—as a novelist was the rival of Fielding. His chief works are: *The Adventures of Roderick Random*, *Peregrine Pickle*, and *Humphry Clinker*, p. 285.

Southey, Robert (1774—1843), born at Bristol—a poet of the first rank—Chief poems: *Thalaba*, an Eastern tale; *Madoc*, founded on a Welsh story; *The Curse of Kehama*, a tale of Hindu superstition; and *Roderick, the Last of the Goths*, p. 227

Spenser, Edmund (1553—1598), among English poets, excelled only by Shakspeare, Chaucer, and Milton. His great work is *The Faerie Queene*, an allegorical poem, designed to celebrate the principal virtues, p. 177.

Steele, Richard (1675—1729), Gazette-writer to the Whig ministry in the reign of Queen Anne—shares with Addison the honour of having founded our periodical literature. They issued successively the *Tatler*, *Spectator*, and *Guardian*, p. 265.

Sterne, Laurence (1713—1768), an eccentric English clergyman—celebrated for his *Life of Tristram Shandy*, and his *Sentimental Journey through France and Italy*, p. 282.

Swift, Jonathan (1667—1745), Dean of St Patrick's, Dublin—the most powerful and original prose-writer of his time. His most popular works are: *Gulliver's Travels*, *The Tale of a Tub*, and *The Battle of the Books*, p. 271.

Taylor, Jeremy (1613—1667), Bishop of Down and Connor, and of Dromore—one of the most admired writers on theology—Chief works: *The Liberty of Prophesying*, *Holy Living and Holy Dying*, *The Life of Christ*, *The Golden Grove*, and *Sermons*, p. 253.

Tennyson, Alfred (1810—), the son of a Lincolnshire clergyman—the greatest of our living poets—became poet-laureate on the death of Wordsworth—Chief poems: *The Princess*, *In Memoriam*, *Maud*, *Idylls of the King*, *Enoch Arden*, and many miscellaneous poems, p. 249.

Thackeray, William Makepeace (1811—1863), born at Calcutta—the greatest novelist since Scott—Chief works: *Vanity Fair*, *Pendennis*, *Esmond*, *The Newcomes*, *The Virginians*, *Lovel the Widower*, *Philip*, and his lectures on *The English Humourists* and on *The Four Georges*, p. 313.

Thomson, James (1700—1748), the son of a Scottish clergyman in Roxburghshire—noted for his poems on *The Seasons*, on *Liberty*, and *The Castle of Indolence*, a poem in imitation of Spenser, p. 206.

Wordsworth, William (1770—1850), one of our greatest poets. From the residence of Wordsworth, Coleridge, and Southey near each other among the lakes of Westmoreland and Cumberland, they have been termed 'The Lake Poets.'—Chief poems: *The Excursion*, *Lyrical Ballads*, *The White Doe of Rylstone*, *Peter Bell*, *the Waggoner*, and one of the finest collections of sonnets in the language, p. 221.

Young, Edward (1681—1765), at first a courtier, and afterwards one of the king's chaplains—best known by his poem entitled *Night Thoughts*, and the tragedy of *Revenge*, p. 205.

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